DIV. OF FISHES

COMMERCIAL FISHERIES Review

VOL. 33, NO. 2 FEBRUARY 1971

MUSEUMS LIBRARY

DEPOSITED BY THE UNITED STATES OF AMERICA

MUSEUM
SH
11
A47
vol. 33
no. 2

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

National Marine Fisheries Service

U.S. DEPARTMENT OF COMMERCE
Maurice H. Stans, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Dr. Robert M. White, Administrator
Howard W. Pollock, Deputy Administrator
John W. Townsend, Jr., Associate Administrator

NATIONAL MARINE FISHERIES SERVICE
Philip M. Roedel, Director

COVER: Unloading catch from a dugout canoe in Dahomey.

Until recently, lagoon fishing supported about 100,000 people. But deterioration of this source has forced fishermen to go to sea. They have been helped by FAO project involving use of outboard motors on their canoes. These enable them to seek out previously inaccessible offshore grounds. (FAO: G. Tortoli)

COMMERCIAL FISHERIES

Review

A comprehensive view of United States and foreign fishing industries--including catch, processing, marketing, research, and legislation--prepared by the National Marine Fisheries Service (formerly Bureau of Commercial Fisheries).

FISHERMEN'S MEMORIAL--GLOUCISTER, MASS.

Managing Editor: Edward Edelsberg

Production: Jean Zalevsky
Alma Greene

Throughout this book, the initials NMFS stand for the NATIONAL MARINE FISHERIES SERVICE, part of NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA), U.S. Department of Commerce.

Address correspondence and requests to: Commercial Fisheries Review, 1801 North Moore Street, Room 200, Arlington, Va. 22209. Telephone: Area Code 703 - 557-4246.

Publication of material from sources outside the Service is not an endorsement. The Service is not responsible for the accuracy of facts, views, or opinions of these sources.

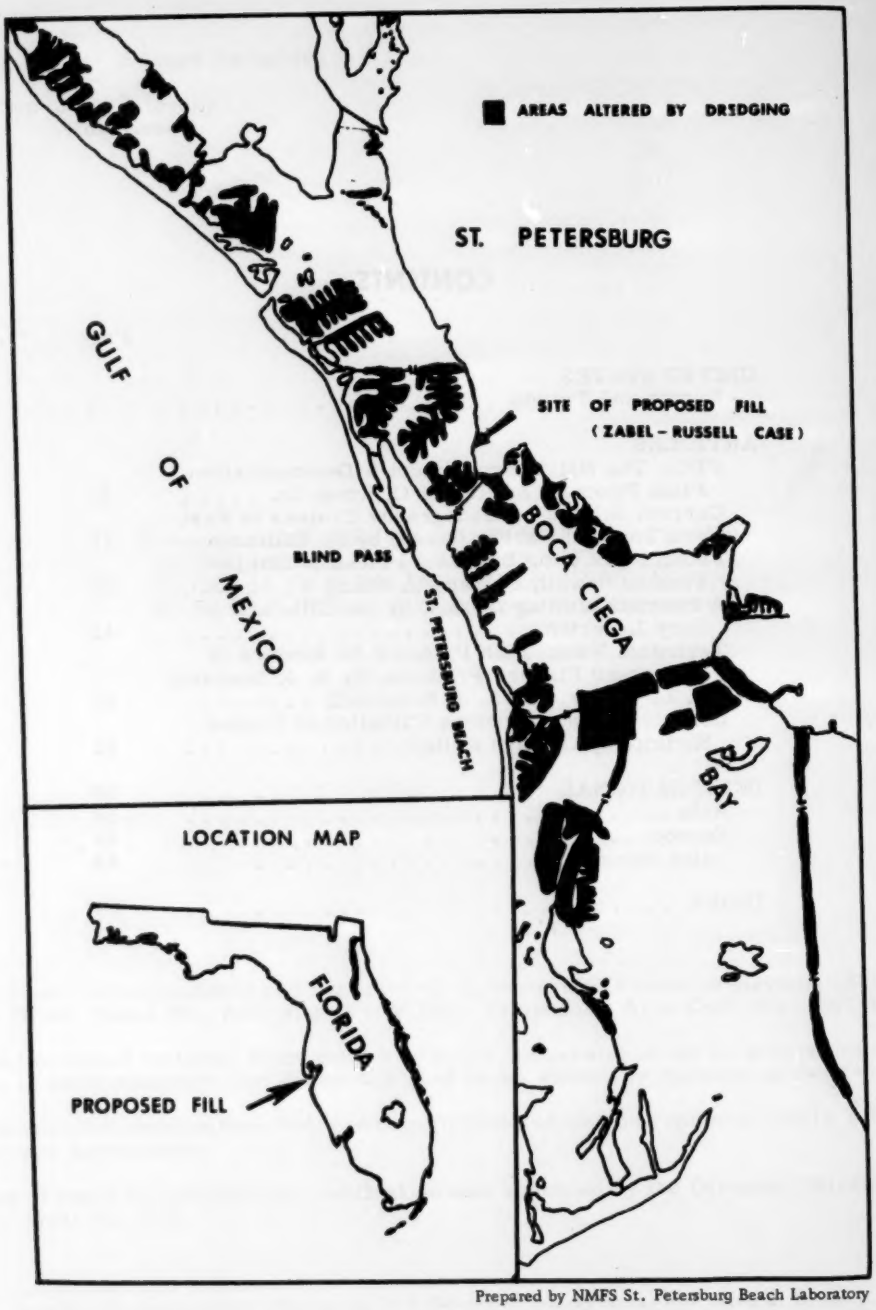
Although the contents have not been copyrighted and may be reprinted freely, reference to source is appreciated.

Use of funds for printing this publication was approved by the Director, Bureau of the Budget, April 18, 1968.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.
Price 60 cents (single copy). Subscription Price: $7.00 a year; $2 additional for foreign mailing.

CONTENTS

	Page
UNITED STATES	
Events and Trends	1
ARTICLES	
FPC: The NMFS Experiment & Demonstration Plant Process, by Robert C. Ernst Jr.	22
Current Skipjack Oceanography Cruises in Eastern Tropical Pacific Ocean, by F. Williams	29
Factors Affecting Exvessel Prices of Skipjack Tuna in Hawaii, by Yung C. Shang	39
A Buoyline Coiling Device, by Ian Ellis and Gary Loverich	42
Technical Note: Fish Proteins As Binders in Processed Fishery Products, by R. J. Learson, B. L. Tinker, and L. J. Ronsivalli	46
Glucose Oxidase Reduces Oxidation in Frozen Shrimp, by Carolyn Kelley	51
INTERNATIONAL	53
Asia	54
Europe	61
Latin America	63
INDEX	64



Prepared by NMFS St. Petersburg Beach Laboratory

SUPREME COURT UPHOLDS ARMY ENGINEERS' VETO OF FLORIDA DREDGE PLAN

In a landmark decision that cheered conservationists, the U.S. Supreme Court, on Feb. 22, 1971, upheld the right of the U.S. Army Corps of Engineers to deny a permit for dredging and filling in navigable waters if the work threatens to injure fish and wildlife. The court action climaxed nearly 12 years of litigation on the Zabel-Russell project in Boca Ciega Bay, near St. Petersburg, Florida. A lawyer for the private interests said: "This is the end of the line. There is no more Zabel-Russell fill proposal."

Background of Case

The controversy began in 1958 when D.H. Russell and A.G. Zabel applied for dredge and fill permit. They had developed the Causeway Village trailer park on land they owned on Boca Ciega bayfront in S. Pasadena, southwest of St. Petersburg. They wanted to create an $11\frac{1}{2}$-acre island in the bay west of their trailer park. They planned to get the fill they needed for the island by dredging the bay. Connected by a bridge to the mainland, the island would become an extension of the trailer park.

Conservationists Oppose Plan

Conservationists organized quickly to resist the plan. For years they had criticized the Corps of Engineers for damaging the environment with unneeded landfills, reclamation of wetland, and alterations of stream channels.

Local and national conservation groups were backed by Interior Department's Bureau of Sport Fisheries and Wildlife, the Florida Department of Natural Resources, some Florida legislators, and the Pinellas County Commission.

Playing important background roles were biologists of the NMFS St. Petersburg Beach Laboratory under Jim Sykes, and Ed Arnold, Chief of NMFS Southeast Region's Office of Water Resource Studies. The biologists had been studying Gulf Coast estuaries for years. They concluded that land fills already caused an annual loss of $1.4-million in fishery products in Boca Ciega. When the Engineers asked their opinion, they voted no.

In 1967, the Corps of Engineers, after asking and receiving the opinions of several government agencies, denied the permit. In that year, U.S. District Judge Ben Krentzman of Tampa reversed the denial.

On July 17, 1970, the U.S. 5th Circuit Court of Appeals in New Orleans, Louisiana, overturned Judge Krentzman's decision.

The Appeals Court noted that the permit application would have been granted several years ago when the Corps of Engineers dealt only with navigation. But, the court emphasized, that was "before man's explosive increase made all, including Congress, aware of civilization's potential destruction from breathing its own polluted air and drinking its own infected water and the immeasurable loss from a "Silent Spring"-like disturbance of nature's economy."

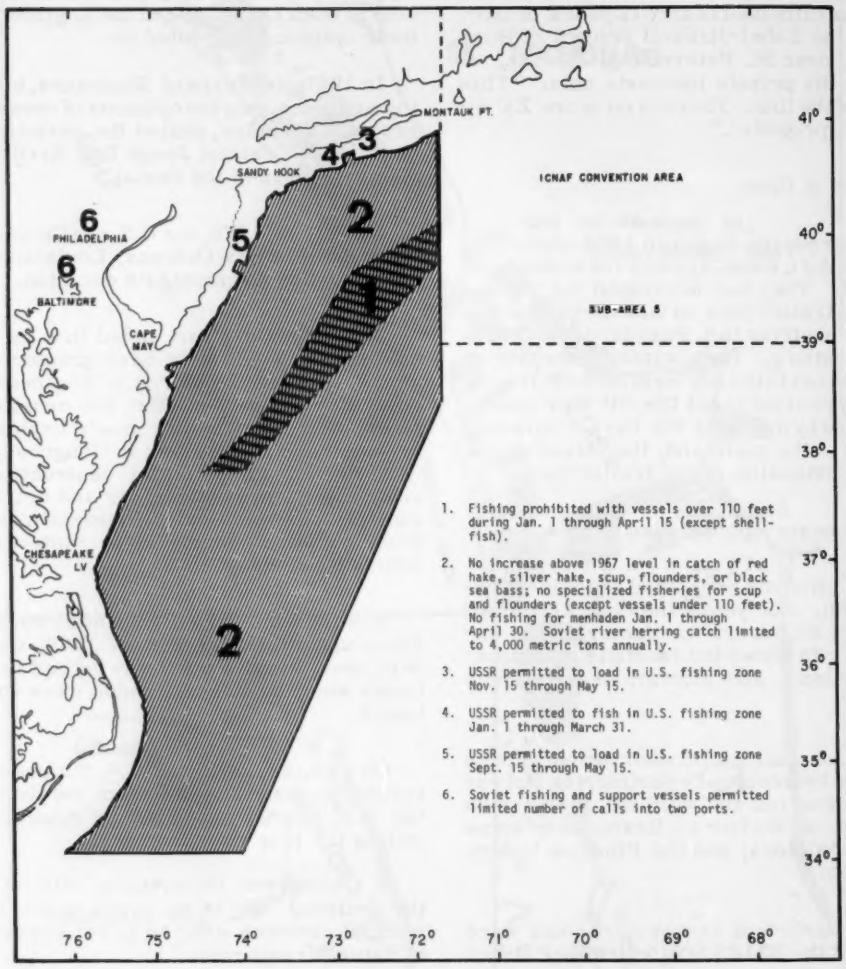
Now the engineers are bound by the National Environment Policy Act of 1969, the Court held, even though the Act was not on the statute books when the Russell-Zabel case was first heard.

On Feb. 22, 1971, the U.S. Supreme Court refused to hear an appeal from the decision of the U.S. 5th Circuit Court of Appeals--thus ending the long controversy.

A Commerce Department official called the decision "one of the most significant judicial decrees ever to affect conservation of natural resources."

U.S.-SOVIET FISHERIES AGREEMENT

effective Jan. 1, 1971


MONTAUK PT.
SANDY HOOK
PHILADELPHIA
BALTIMORE
CAPE MAY
CHESAPEAKE LV
ICNAF CONVENTION AREA
SUB-AREA 5
41°
40°
39°
38°
37°
36°
35°
34°
76°
75°
74°
73°
72°
71°
70°
69°
68°
1. Fishing prohibited with vessels over 110 feet during Jan. 1 through April 15 (except shellfish).
2. No increase above 1967 level in catch of red hake, silver hake, scup, flounders, or black sea bass; no specialized fisheries for scup and flounders (except vessels under 110 feet). No fishing for menhaden Jan. 1 through April 30. Soviet river herring catch limited to 4,000 metric tons annually.
3. USSR permitted to load in U.S. fishing zone Nov. 15 through May 15.
4. USSR permitted to fish in U.S. fishing zone Jan. 1 through March 31.
5. USSR permitted to load in U.S. fishing zone Sept. 15 through May 15.
6. Soviet fishing and support vessels permitted limited number of calls into two ports.

U.S. & USSR SIGN MID-ATLANTIC FISHERIES AGREEMENT

On Dec. 11, 1970, the U.S. and the Soviet Union signed an agreement in Washington on fisheries off the U.S. Middle Atlantic coast. It took effect Jan. 1, 1971. An addition to the agreement was signed Feb. 2, 1971. The area covered extends roughly from west of Block Island in north to Cape Fear (North Carolina) in south.

The agreement extends and modifies U.S.-USSR Mid-Atlantic agreements of 1967 and 1968.

The new agreement affords greater protection for 4 species important to U.S. sports and commercial fishermen. It extends conservation measures to 3 more species.

Provisions of Agreement

In northern part of agreement area, protection was increased for red hake, silver hake, scup, and flounders, species previously covered under U.S.-USSR agreement. Protection was extended to black sea bass, important to U.S. sports fishermen.

A specified offshore area (see map), closed to large vessels from Jan. through March under 1968 agreement, will now be closed Jan. 1 through April 15. The area is on high seas well outside U.S. jurisdiction. The closure protects vulnerable winter concentrations of scup and flounders. It ensures access of red and silver hake to spawning grounds. The added two weeks' protection comes at a very critical spawning period, say U.S. scientists who participated in the negotiations. It is a significant limitation on Soviet fishery.

Significant Changes

In southern part of agreement area, said Ambassador Donald L. McKernan, head of U.S. delegation, two significant changes are valuable to U.S. fishing interests:

"First, the southern boundary . . . has been extended approximately 75 miles from Cape Hatteras almost to Cape Fear. Vulnerable stocks of fish which are of great value to the American fishermen in this area will now be subject to conservation regulations. In the absence of this Agreement, Soviet fishermen would be free to fish for any species in any quantity, for Soviet law permits controls over their fishermen only pursuant to such international agreements."

Second, menhaden, the largest U.S. fishery in Mid-Atlantic, is now covered. "Offshore fishing for menhaden will be prohibited during the months of January through April. During these months the menhaden spawn offshore. This limitation will ensure that the stock will reproduce and return to the inshore area where it is subject to the U.S. fishery during other months of the year."

In the addition to the Agreement, Feb. 2, 1971, the Soviets agreed to limit their catch of river herring to 4,000 metric tons a year.

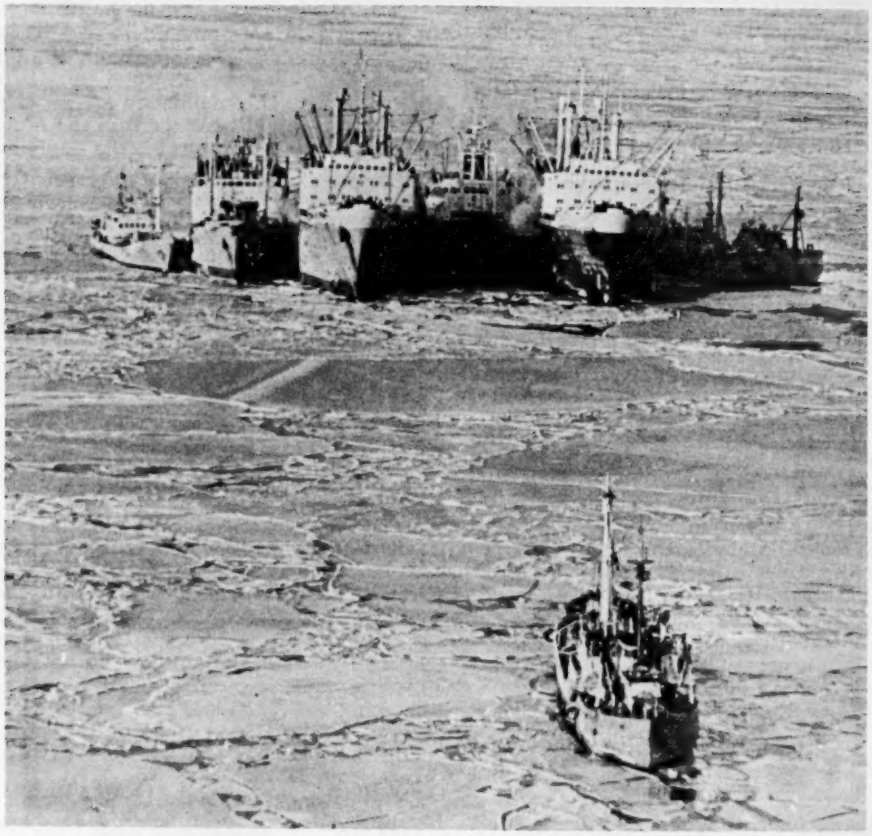
The two delegations also agreed that there is an urgent need to adopt conservation measures in the Mid-Atlantic for the depleted sea herring.

Soviets Allowed Loading Areas

The Soviet fishing fleet will continue to be allowed to use for loading 2 small areas within the U.S. 9-mile contiguous fishing zone off New Jersey and Long Island. Also, the U.S. will permit the Soviets to fish in a small area off Long Island during specified periods during the winter. In addition, in return for Soviet cooperation in conserving species of special concern to U.S. fishermen, entry by Soviet fishing vessels into certain U.S. ports was made easier.

The new agreement is for 2 years. It can be amended any time, as contemplated for river herring and sea herring, or even be renegotiated.

The U.S. delegation included Federal, state, and local experts. The Soviet was led by First Deputy Fisheries Minister V.M. Kamentsev. (U.S. State Dept., Dec. 11, 1970, and Feb. 2, 1971.)



Far from stormy seas, 7 Soviet vessels--motherships to medium side trawlers--nest together to transfer fish and cargo. Another side trawler approaches to make delivery. The vessels belong to Soviet herring fleet, which was operating near St. Matthew Island in Bering Sea. Fleet was anchored 30 or more miles from ice. It is common practice for ships to take shelter from seas and icing conditions by running inside the ice. All Soviet vessels in this winter fishery are reinforced for travel in pack ice. (Photo: M. C. Zahn, Dec. 31, 1969.)

U.S. & USSR SIGN 3 AGREEMENTS

The U.S. and the Soviet Union signed 3 agreements on Feb. 12, 1971, relating to northeastern Pacific fishery problems. The agreements, which replace three previous ones, became effective immediately and will remain in effect for 1971 and 1972. They were signed by U.S. Ambassador Donald L. McKernan and Vladimir M. Kamentsev, Soviet Deputy Minister of Fisheries.

I. Eastern Bering Sea Crab Fisheries

It was agreed that the Soviet harvest of king and tanner crabs be reduced to 23,000 cases of canned crab (56% reduction in quota) and 35,000 cases of canned tanner crab (12.5% reduction in quota). Also, the legal minimum size of harvestable male king crabs was increased from $5\frac{3}{4}$" to $6\frac{1}{4}$". However, the Soviet representatives stated that they would take no more than 12,800 cases of king crab of their quota of 23,000 cases. It was agreed that, in view of this catch level, the increased minimum size limit would not apply to Soviet fishermen in 1971 and 1972.

Also, the Soviet Union will reduce amount of tangle net gear used to capture crabs in 1971 and 1972. She will emphasize development and use of pot gear used by U.S. fishermen. The sanctuary where only crab pots may be used will be retained. This area is closed to trawling to prevent conflicts arising from the use of stationary instead of mobile fishing gear.

The two other new agreements provide improved protection for stationary fishing gear to conform to king crab and tanner crab fishing season in areas westward along Aleutian Islands and in Gulf of Alaska near Kodiak Island. The period closed to mobile gear in 3 of the 6 areas off Kodiak was extended by $3\frac{1}{2}$ months.

To reduce conflicts between trawl fishermen and halibut fishermen, special measures are provided for 3 main halibut fishing grounds in eastern Bering Sea and 3 areas in Gulf of Alaska--including a closure to mobile gear during beginning of halibut fishing season.

II. Off Washington, Oregon, California

The existing 6 areas on high seas established to protect Pacific Ocean perch and other species of rockfishes were expanded seaward from 450-meter depth to 600-meter depth.

The period in which trawling will be prohibited during winter months in these 6 areas when perch and other shelf rockfishes congregate also was increased by 15 days.

It was agreed that other measures--use of trawl nets of certain mesh sizes, avoidance of areas of rockfish concentration, catch limitations--would be implemented to provide increased protection for these resources.

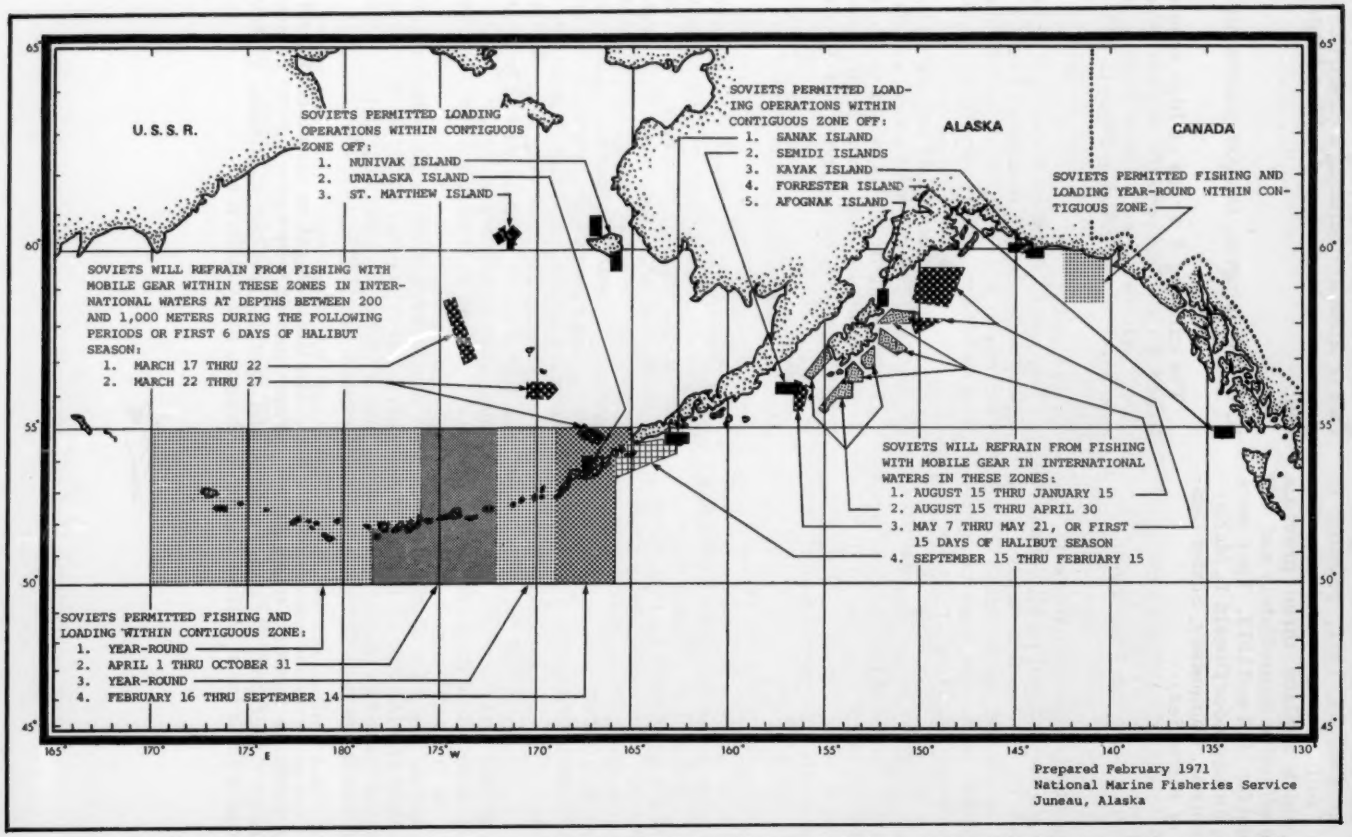
III. 3-12-Mile Zone In Aleutians

In return for concessions on high seas granted to U.S., the USSR will be permitted to continue fishing for finfishes in 3- to 12-mile zone in Aleutian Islands when U.S. crab fishermen are not operating there. Also, the Soviets will be able to load and transfer in U.S. contiguous zone in 3 new localities: Semidi Islands in Gulf of Alaska, and St. Matthew Island and Makushin Bay in Bering Sea. Soviet fishing and support vessels will be permitted to make up to 4 calls per month at Pacific Coast ports of Seattle, Wash., and Portland, Oregon.

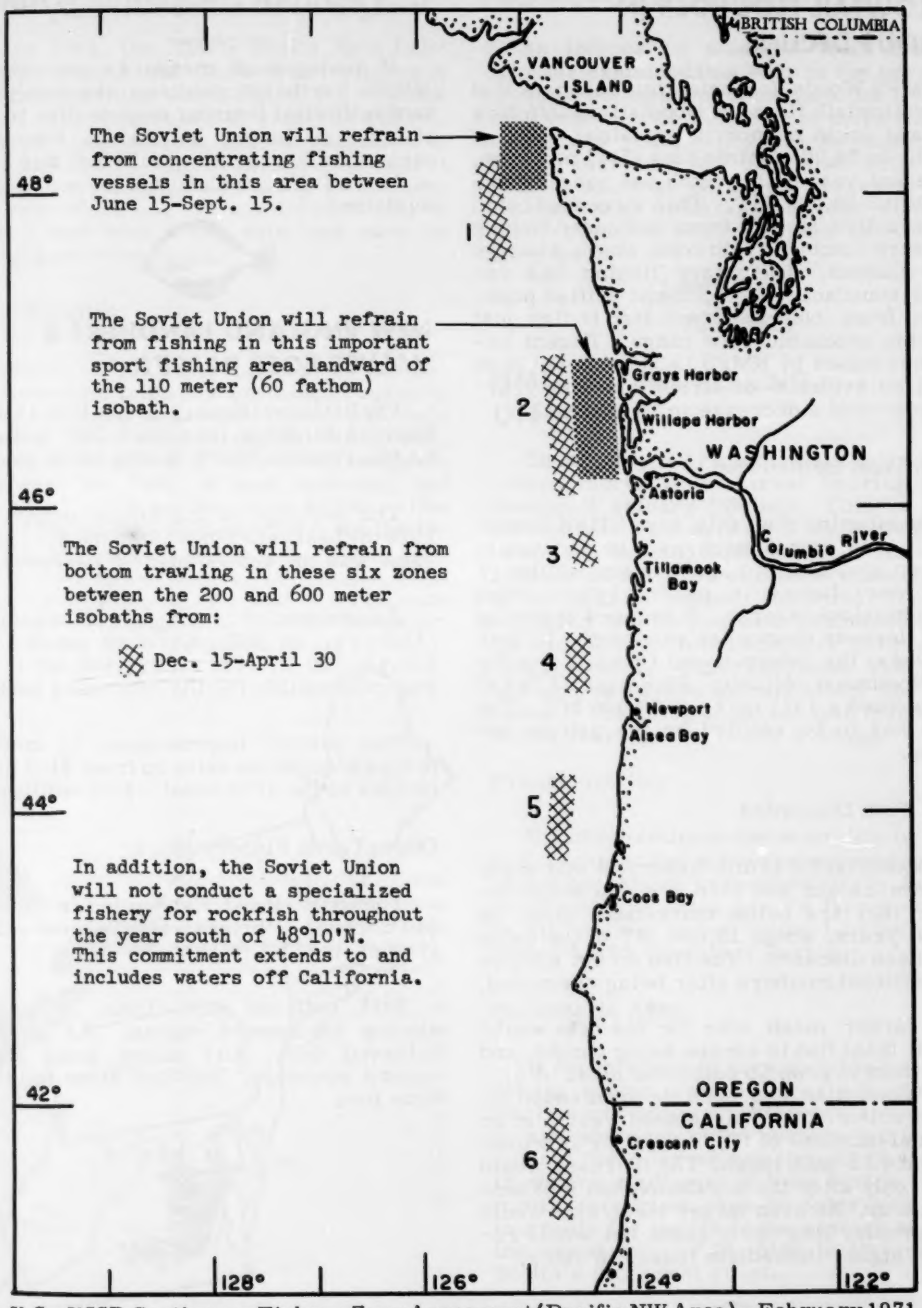
The new agreements provide for cooperation in fishery research on fish stocks of mutual concern and exchange visits to fishing vessels.

The U.S. delegation also included advisers from state fishery agencies and commercial and sports fisheries of Alaska, Washington, Oregon, and California.

→


U.S.S.R.
ALASKA
CANADA
SOVIETS PERMITTED LOADING OPERATIONS WITHIN CONTIGUOUS ZONE OFF:
1. NUNIVAK ISLAND
2. UNALASKA ISLAND
3. ST. MATTHEW ISLAND
SOVIETS PERMITTED LOADING OPERATIONS WITHIN CONTIGUOUS ZONE OFF:
1. SANAK ISLAND
2. SEMIDI ISLANDS
3. KAYAK ISLAND
4. FORRESTER ISLAND
5. AFOGNAK ISLAND
SOVIETS PERMITTED FISHING AND LOADING YEAR-ROUND WITHIN CONTIGUOUS ZONE.
SOVIETS WILL REFRAIN FROM FISHING WITH MOBILE GEAR WITHIN THESE ZONES IN INTERNATIONAL WATERS AT DEPTHS BETWEEN 200 AND 1,000 METERS DURING THE FOLLOWING PERIODS OR FIRST 6 DAYS OF HALIBUT SEASON:
1. MARCH 17 THRU 22
2. MARCH 22 THRU 27
SOVIETS WILL REFRAIN FROM FISHING WITH MOBILE GEAR IN INTERNATIONAL WATERS IN THESE ZONES:
1. AUGUST 15 THRU JANUARY 15
2. AUGUST 15 THRU APRIL 30
3. MAY 7 THRU MAY 21, OR FIRST 15 DAYS OF HALIBUT SEASON
4. SEPTEMBER 15 THRU FEBRUARY 15
SOVIETS PERMITTED FISHING AND LOADING WITHIN CONTIGUOUS ZONE:
1. YEAR-ROUND
2. APRIL 1 THRU OCTOBER 31
3. YEAR-ROUND
4. FEBRUARY 16 THRU SEPTEMBER 14
65°
60°
55°
50°
45°
165° 170° 175° E 180° 175° W 170° 165° 160° 155° 150° 145° 140° 135° 130°
Prepared February 1971
National Marine Fisheries Service
Juneau, Alaska

U.S.-USSR Fisheries Agreements Concerning the U.S. Contiguous Fishery Zone Off Alaska, February 1971.



U.S.-USSR Contiguous Fishery Zone Agreement (Pacific NW Area) - February 1971.

YELLOWTAIL FLOUNDER IN SERIOUS DECLINE

NMFS Woods Hole scientists estimate that the yellowtail flounder populations off New England could support a sustained yield of 21,000 to 34,000 metric tons (MT) per year. In recent years, the catch has ranged from 43,000 to 58,000 MT. This increased catch has resulted largely from increased fishing pressure combined with some above-average year-classes. The heavy fishing has reduced abundance of stocks and shifted population from older, larger fish to fish just entering catchable size range. Recent research cruises by NMFS 'Albatross IV' have found no evidence of strong entering year-classes--and a decrease in total stock.

Catch Must Be Reduced

The meaning of all this, says NMFS Northeast Region, is that catch must be reduced to build up spawning stocks. The probability of good year-classes is much higher when spawning stock is large. A reduced spawning stock lessens chance for recovery. To help recovery, the International Commission for the Northwest Atlantic Fisheries (ICNAF) has adopted a 1971 quota of 29,000 MT. The quota has to be ratified by the nations involved.

Many Fish Discarded

Another factor in this fishery is that many fish are caught and then are discarded because they are below marketable size. In recent years, about 10,000 MT of the catch have been discards. The fish do not survive in significant numbers after being discarded.

A larger mesh size for the nets would permit these fish to escape being caught, and allow them to grow to catchable size. A 5.1-inch mesh size has been recommended by NMFS scientists. This should result in an eventual increase of the harvest by 10% over current 4.15-inch mesh. The increase would occur only after the population had a chance to build up. An even larger mesh size would have greater long-term gains but would result in higher immediate losses in catch.

Management Measures Necessary

If management measures are not taken, NMFS Northeast cautions, the once-important yellowtail flounder may decline to where it may no longer be viable. Management measures begun now could halt this decline and permit the population to support a sizable sustained yield.

NEW ENGLAND LANDINGS & VALUES ROSE IN 1970

Preliminary figures show that 1970 New England landings increased 24% and values 13.5%, reports NMFS Northeast Region.

The landings of 1.3 billion pounds made 1970 the best year since 1966; the $161 million value was the second highest recorded.

An unexpected resurgence of the menhaden fishery, up 280 million pounds, from 225,434,000 in 1969 to 505,182,000 in 1970, was responsible for the increased landings.

The overall improvement in most fish prices brought the value up from $142 million in 1969 to the 1970 level--$161 million.

Otter-Trawl Fishery No. 1

The otter-trawl fishery led in value with $40 million. Lobsters were the most valuable species at $31.7 million.

Surf, soft and hard clams, lobsters, and shrimp hit record values. No finned fish achieved this. Surf clams alone reached record poundage. Haddock alone fell to all-time low.

MONITOR SPAWNING HADDOCK

Since 1968, the NMFS Woods Hole Laboratory (Mass.) has been monitoring each year the spawning condition of the haddock stocks. The stocks are at a very low level. The poor recruitment for the past several years has led to a peculiar age structure: Most of the mature fish belong to the last good year-class and are now 8 years old. It is not known what effect this may have on spawning success.

14,000 Samples

Samples of fish from commercial and research-vessel trips are examined regularly as the spawning season advances and their degree of maturation recorded. Since 1968, over 14,000 haddock have been sampled. Each year the date of peak spawning has been earlier than the year before. One hypothesis is that this results from the increasing average age of the fish. Older haddock usually spawn before the younger ones. Another possibility is that this is a response to a slight warming trend in water temperature over the past few years.

1969 Year-Class Haddock

An interesting sidelight from the first samples examined this year is the presence, about 10% of total, of some haddock from the 1969 year-class. Very few of these fish will spawn this year. They are so small, 34 to 47 cm, that they will contribute little to the total production of eggs. However, their presence may mean that this year-class was underestimated when sampled as young-of-the-year.

NMFS STUDIES HERRING OFF MAINE

Each year, NMFS biologists estimate the winter mortality of larval herring in the Sheepscot estuary (Maine). This is one of the methods used to predict the abundance of immature herring that will be available for canning as sardines along the western coast of the Gulf of Maine. The winter (1970-71) mortality for this year was estimated as 37% for 15 days from mid-December 1970 to mid-January 1971. This was less than a year ago and about average (35%) for the past 7 years. The catch of larvae was much lower than a year ago and below average.

Frenchman Bay

Efforts to estimate the mortality of larvae in Frenchman Bay in the eastern sector of the Maine coast were unsuccessful--by January, no larvae were in the bay. A larvae scarcity in this sector is not unusual in the winter, states NMFS Northeast Region.

No Suitable Area

It appears that an area suitable for determining winter mortality does not exist from Mt. Desert eastward. However, larvae usually are abundant in the eastern sector in the spring; these larvae are thought to originate in waters southwest of Nova Scotia. So, the most appropriate area to determine winter mortality for larvae in the eastern sector of the coast may be St. Mary's Bay on Nova Scotia's southwest coast.

E. COAST DEEP-WATER LOBSTERS TRANSPLANTED IN PACIFIC NW

A feasibility study on transplanting East Coast deep-water lobsters (homarus americanus) to Oregon waters was initiated in December 1969 by University of Rhode Island (URI), Oregon State University, and Oregon Fish Commission. Capt. James McCauley carried out URI's part by supplying more than 500 lbs. of adult lobsters and air-shipping them to Oregon. The lobsters were obtained from the offshore population and consisted of males and berried females. The shipping mortality was less than one percent. Most were judged extremely hardy on arrival in Oregon.

Unfavorable Hydrographic Conditions

Prof. Jeff Gonor, Oregon State Marine Science Center, Newport, Oregon, has informed URI that hydrographic conditions at 100-fathom line do not permit adequate survival of larvae released by berried females. Surface-water temperature off Oregon in spring and summer usually averages around 12° C (about 54° F). which causes exceedingly slow development of larvae. In turn, this results in exposure of larvae to surface and midwater predators for so long a period that entire stock is eliminated.

Other Experiments Promising

However, other experiments with the lobsters have indicated "potentially promising developments" in another area. The seasonal temperature fluctuations of the sea water supply from the bay adjacent to Oregon's Marine Science Center is adequate for adult survival. In fact, summer refrigeration would not be needed for any holding pounds between northern California and Washington.

Thus, says URI, there appears to be merit in considering commercial sales of lobster from holding pounds on U.S. northwest coast. The pounds could be stocked during peak landings on east coast--and might stabilize price to lobstermen at desirable level.

RECORD SHRIMP CATCH SET ON PACIFIC COAST IN 1970

The 1970 shrimp catch along the Pacific coast hit a record 92.4 million pounds, heads on, up 29.9 million pounds (48%) from 1969's record 62.5 million pounds.

The fast-growing Alaskan shrimp fishery soared to record 74 million pounds, heads on, a rise of 26.2 million pounds (55%) from 1969.

Also records were Oregon's 13.4 million pounds and California's 4.038 million.

Kodiak Sets Pace

Kodiak's shrimp landings of 62.4 million pounds were 84% of Alaska's total--and 68% of entire Pacific Coast catch.

COMMERCIAL FISHING COURSE AT BELLINGHAM, WASH.

The Bellingham Technical School in Washington State is conducting a fishery training course designed to prepare persons for work on commercial fishing vessels. The graduates will be able to serve on vessels used for purse seining, otter trawling, gillnetting, reef netting, trolling, and halibut fishing.

The Curriculum

The 10-week course, Feb. 22-April 30, has daily classes--on commercial fishing, orientation on vessel, basic seamanship, navigation techniques and rules, safety rules, marine engines and power equipment, fishing gear, assembling and repairing fishing gear, species of commercial fish and their care and handling.

STUDY EFFECTS OF STARVATION ON SWIMMING OF YOUNG JACK MACKEREL

Drs. John Hunter and Reuben Lasker began an experiment in January 1971 to determine the effects of starvation on the extent and distribution of fat and glycogen reserves, and on swimming abilities, in juvenile young-of-the-year jack mackerel. The work will help determine the likelihood of survival of young-of-the-year juveniles during their first winter--when effects of mortality on year-class strength may be most significant.

The scientists are with NMFS Fishery, Oceanography Center, La Jolla, Calif.

Fish were starved for 45 days and samples taken for biochemical analysis at 5-day intervals. Endurance swimming of the fish was tested at beginning and at end of experiment.

Preliminary Findings

Preliminary analysis of the biochemical data indicates that the fat concentration of the viscera declined about 50% over the 45-day starvation period. Fat concentration in the red muscle, and the total mass of that muscle, declined about 50%. But the fat concentration in the white muscle dropped about 90%, and was nearly undetectable in some samples.

Glycogen concentrations of red and white muscle dropped in first 15-20 days, but then stabilized or decreased only slightly.

The ability of the fish to sustain speed threshold was affected only minimally by the 45-day starvation period. The 6-hour swimming 50% fatigue threshold for starved fish was within the interval 98-121 cm/sec, whereas the controls fell within the interval 121-139 cm/sec.

Fish Adjusted

The juvenile jack mackerel adjusted to a 45-day starvation period by using the extensive fat reserves of the viscera (about 60% its dry weight was fat) and the fat in white muscle (about 11% dry weight of muscle). The ability of the fish to withstand strenuous swimming for extended periods was not greatly affected because they maintained glycogen above critical levels in both white and red muscles.

GENERATIONS OF PLANKTON REARED IN LAB

Dr. Michael R. Reeve has reared planktonic chaetognath (Sagitta hispida) through more than one generation in the laboratory, reports the University of Miami's School of Marine and Atmospheric Science.

The minute, transparent, sea animal was "reared from egg to adult and the second-generation egg stage in 3 to 4 weeks."

Scientists believe chaetognaths are second most important animal plankton in many parts of the oceans. They feed on copepods, the primary animal plankton group that eats plants. S. hispida is common in Florida coastal waters.

Meaning of Achievement

The school believes that Dr. Reeve's success brings closer the time when interactions of microscopic marine animals and plants--which form base of marine-food production and distribution web--may be seen in miniature laboratory communities.

3,325 WHALES PASS YANKEE POINT, CALIF., IN 67-DAY CENSUS

The annual count of migrating gray whales at Yankee Point, near Monterey, Calif., was completed Feb. 13, 1971, reports NMFS Fishery-Oceanography Center, La Jolla. Robert Strawn and Stephen Treacy counted 3,325 whales moving south past the Point during daylight.

The total gray-whale population--including allowance for whales that passed at night and those missed in periods of poor visibility--was estimated at about 10,000-11,000. The annual counts have remained about the same for the past 4 years; the population size appears "essentially stable".

NMFS BEGINS COOPERATIVE FISHERY-ADVISORY PROGRAM WITH TUNA FISHERMEN

A gray box is being added to the chart-room equipment of San Diego-based tuna purse seiners, which fish for yellowfin and skipjack tuna in the eastern Pacific Ocean. Installed by technicians of NMFS Fishery-Oceanography Center, La Jolla, Calif., the boxes are radio facsimile recording sets. These are able to receive direct oceanographic and weather information on 12- by 19-inch charts transmitted daily by Federally licensed radio station WWD at nearby Scripps Institution of Oceanography.

Environmental Data From Vessels

Dr. Alan R. Longhurst, Director of the Center, explains that this fishery advisory service is being tried experimentally to obtain environmental data from fishing vessels, and to provide fishermen with information that may help them make tactical fishing decisions. He emphasizes that the environmental data collected by fishermen are necessary for use in the Center's development of fishery-forecasting techniques and methods for tropical tunas.

Each day, information on sea-state, including direction and height of swells, and height of wind-waves is plotted onto a chart for transmission to fishermen on the fishing grounds; weekly, an analysis of 7-day sea-surface temperatures is plotted for transmission.

Chart Information

A second daily chart provides information on direction and speed of surface winds, location and direction of movement of tropical storms, and location of areas of squalls and potentially threatening weather conditions.

In the near future, a weekly analysis of mixed layer depths, the depth at which warm surface waters meet cooler waters below, also will be included in the charts.

Eventually, the location of small-scale ocean-surface temperature features as indicated by temperature measures made by orbiting weather satellites and received at the Center also will be added to the charts. The charts cover the American west coast to 140° W., between latitudes 30° N and 5° S. According to Dr. M. Laurs, leader of Fishery-Oceanography Program, who is directing the work, the information on the charts is tailored to needs of fishermen on tuna fishing grounds in eastern tropical Pacific.

OREGON FISH COMMISSION SURVEYS ESTUARIES

The Fish Commission of Oregon began an intensive study of the state's estuaries on March 1. Purpose is to determine how many people use the estuaries, the distribution of these people, and how much of the harvest of fish and shellfish is for personal use. Commission biologists aided by State Game Commission personnel will survey the state from the Columbia River in the north to the Chetco River on the south coast.

Importance of Estuaries

Marine biologists note the importance of estuaries as a rich feeding ground for young fish and shellfish, and as spawning grounds for marine finfish. The biologists are interested particularly in bay clams, an important recreational and commercial shellfish found only in the tidal areas of Oregon's estuaries. Rich nutrients, sheltered waters, and ideal spawning conditions make estuaries unique and vital natural resources.

Oregon's estuaries are only 1/10 of 1% of its geographical area, fewer than 56,000 acres in all. All could be placed easily into Willapa Bay, Washington.

Estuaries are under critical pressure from increasing filling, alterations, and development of bay and tideland areas for housing, industry, and highways. Preservation and wise use depend on responsible planning and management, the Commission states.

Public Can Help

Clam diggers and fishermen using Oregon's bays in 1971 have been asked to cooperate with the biologists conducting the resource survey. Their considered answers to questions would produce an accurate reflection of the current use of these bay and river-mouth areas.

Legislation passed in 1969 requires counties to zone their lands by Dec. 31, 1971. The study will be an important guide to city and county planning for the coastal communities. Results will be made available to all agencies planning the protection and enhancement of the state's valuable estuarine resources.

SHELLFISH SITUATION AND OUTLOOK

Richard W. Surdi & Donald R. Whitaker
NMFS Current Economic Analysis Division

Supplies of shrimp available for consumption were a record 541 million pounds, heads-off weight, during 1970. Compared to 1969, supplies of northern shrimp rose 26% to 65 million pounds, while supplies of southern shrimp rose 13% to 476 million pounds.

U.S. landings of shrimp during 1970 were a record 224 million pounds, heads-off weight. Increased landings in the Gulf and the West Coast offset declines in the South Atlantic and New England.

Imports of shrimp rose sharply to 219 million pounds, product weight, during 1970. Each product category of imports rose above the previous year. Imports were again at about 53% of combined total of landings and imports.

In addition to record supplies, consumption was also a record. Increasing about 14%, apparent consumption of shrimp in all forms was 413.7 million pounds, heads-off weight. Northern shrimp sales were 44 million pounds during 1970; consumption of fresh and frozen southern shrimp rose 12% to 339 million pounds, or 95% of total fresh and frozen consumption.

The average price for shrimp landed in U.S. fell to 57.3 cents per pound on heads-off basis. The average wholesale price for 26-30 count raw headless shrimp at Chicago dropped about 4% to $1.26 per pound. The 41-city average retail price for breaded shrimp was $1.63 per pound in 1970--7% above 1969.

About 67.7 million pounds of heads-off shrimp (3.9 million standard cases) were canned in 1970--43% above 1969. Exports of domestic shrimp rose 11% to 40.8 million pounds; exports of foreign-caught shrimp were 14.8 million pounds.

Despite jump in prices during January and February 1971, consumption is expected to be higher than 1970--at about 102 or 103 million pounds for January-April. Canning in Gulf States is expected to total about 800,000 pounds, heads off. Domestic exports of fresh and frozen shrimp may increase slightly to 14 or 15 million pounds in January-April 1971.

January-April 1971 landings in South Atlantic and Gulf are expected to be about equal to 20.6 million pounds in 1970 period. New England landings may decline, but West Coast landings are expected to increase again in 1971.

Despite January decline, imports are expected to rise 2 or 3 million pounds above January-April 1970 to 78 or 79 million pounds, heads off.

The combination of 180 to 182 million pounds of supplies and utilization of 121 to 124 million pounds would result in May 1 stocks of 58 to 60 million pounds--slightly above 56 million pounds on hand May 1, 1970.

SCALLOPS

Supplies of sea scallops in 1970 were 26.1 million pounds. U.S. sea scallop landings of 7.1 million pounds continued the declining trend that began after peak catch in 1961. As abundance has continued to decline, fishing effort has fallen sharply.

U.S. imports of scallops were 16.8 million pounds in 1970--up nearly 18% from 1969. While imports of Canadian scallops declined 10%, substantial increases from other countries more than offset decline.

During 1970, consumption of sea scallops totaled 24 million pounds. Record high prices and low supplies were major factors in this decline. January-April 1971 consumption is expected to slip fractionally from 1970 to a little over 6 million pounds.

January-April 1971 supplies of sea scallops are expected to slip slightly from same period 1970. Landings of sea scallops will probably be lower again this year; the majority of decline is expected in New England. High prices on U.S. market again are likely to spur imports in 1971. Imports during

January-April may increase to about 4.3 million pounds.

Combining supplies of 7.8 million pounds and consumption of 6.2 million pounds would result in about 1.6 million pounds in inventories on May 1.

Total landings of calico scallops were 2.1 million pounds during 1970--up sharply from 183,000 pounds landed during 1969. Most of 1970 catch was landed in North Carolina, which reported 1.8 million pounds.

NORTHERN LOBSTERS

Supplies of northern lobsters during 1970 dropped about 4% from 1969 to 60.6 million pounds, live weight. U.S. landings of northern lobsters were estimated to be 30.4 million pounds--also down 4% from 1969. All of the decline in landings occurred in Maine, which fell about 8% from 1969. A decline in pot fishery was partially offset by increases in the otter trawl and other fisheries.

At 19.5 million pounds (product weight), imports of Canadian lobsters were 5% below 1969 total. All three categories of live, canned, and cooked meat were below previous year.

Demand for northern lobsters continue strong throughout 1970. With supplies slipping somewhat, the high level of demand caused prices to set records.

Supplies of northern lobsters in first 4 months of 1971 are expected to decline slightly from 1970. Preliminary data indicate that Maine landings in January were running below 1970. Imports are also expected to decline.

Declining supplies and continued high demand during January-April likely will result in higher prices than in 1970.

SPINY LOBSTER TAILS

Supplies of spiny lobster tails of 40 million pounds were 6% below record available in 1969. Record-high beginning inventories were more than offset by a 4.8-million-pound drop in imports.

Imports of lobster tails fell 13% to 32.5 million pounds. The share of U.S. market held by cold-water tails continued to slip during 1970; that of warm-water tails rose correspondingly.

Inventories generally declined from a record of 7.5 million pounds on Jan. 1, 1971.

Apparent consumption of spiny lobster tails was a record 35.7 million pounds. This increase was possible because of reductions in inventories. As price rose above 1969's during the last 4 months of 1970, sales dropped off.

January 1970 wholesale prices for 6- to 8-oz. cold-water lobster tails were 81 cents below the previous year. That price rose to a record in November of $4.00 per pound.

Conditions in January 1971 pointed to increase in imports during first 4 months. The level of prices in January, however, appeared prohibitive to greatly increased consumption. If imports rise sharply, prices may dip somewhat from January level.

WEST COAST CRABS

Supplies of West Coast crabs (king, dungeness, and snow) were about 138.5 million pounds, live weight, in 1970. Lower inventories of frozen crabs and imports offset an increase in landings.

West Coast crab landings were 123.4 million pounds, live weight, during 1970. Dungeness-crab landings increased for 6th consecutive year to record 57.2 million pounds. The snow-crab fishery in Alaska rose to 15.2 million pounds, while Alaska king-crab landings declined 12% to 51 million pounds.

During 1970, demand for king and dungeness-crab products improved, but it weakened for snow crabs. Prices for most crab products were below 1969's.

King-crab landings in 1971 may drop below 1970. This would resulted in some crab vessels switching to other fisheries. Although prices of imported canned king crabs are currently (mid-March) below domestic price, some upward pressure may develop if landings are again low in 1971. Dungeness-crab landings may expand somewhat in 1971. But heavy merchandising will be necessary if snow-crab industry is to grow during the year.

THE CHESAPEAKE BAY ROCK CRAB

Dr. Paul A. Haefner Jr. & Roy T. Terretta

Scientists in VIMS' Department of Crustaceology are currently investigating certain aspects of the biology of the rock crab, Cancer irroratus (Fig. 1), in light of its potential for a Chesapeake Bay fishery.

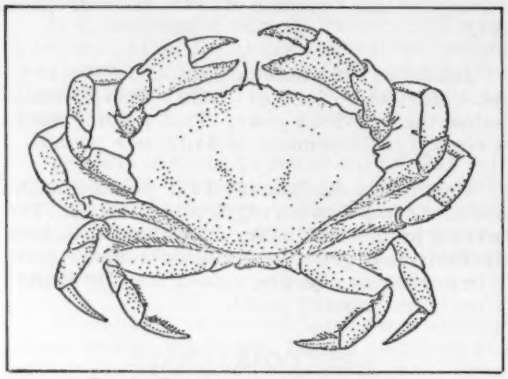


Fig. 1 - The rock crab, Cancer irroratus.

The rock crab ranges from Nova Scotia to the South Atlantic States. Known locally as "stone crab", it should not be confused with Menippe mercenaria, the true stone crab (Fig. 2), which has a southern distribution.

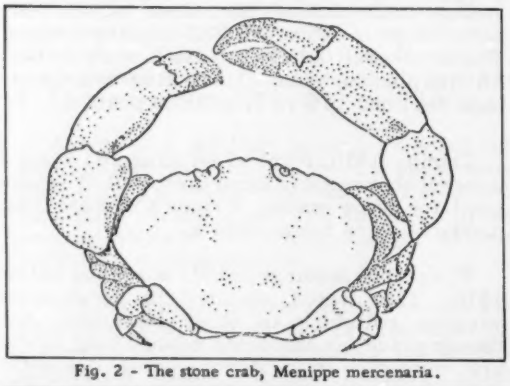


Fig. 2 - The stone crab, Menippe mercenaria.

The rock crab is most abundant along the New England coast where it is the main source of edible crab meat. There is no large commercial fishery in that area primarily because of competition from the lobster industry, but there is no other reason why this crab could not be utilized as a food source. Large crabs reach 6 inches in width and contain a large quantity of meat, especially in the claws. The flavor equals that of the blue crab.

Chesapeake Is Southern Limit

Chesapeake Bay is within the southern limit of the range of the rock crab, a fact obvious from their presence in the catch of the winter dredge fishery for blue crabs. Here rock crabs are now culled and discarded. Some areas of the bay are avoided by dredgers because of the preponderance of rock crabs over blue crabs.

Rock crabs of the lower Chesapeake Bay may be utilized four ways: 1) as picked crab meat; 2) as whole, fresh, or steamed hard crabs; 3) as peeler crabs to shed into soft crabs during the winter months; and 4) as peeler crabs for fishing bait.

Captains Aid VIMS

Virginia dredge-boat captains have been especially helpful by taking VIMS scientists with them during dredging for blue crabs, which began November 30, 1970. First-hand

The authors are in Department of Crustaceology, Virginia Institute of Marine Science, Gloucester Point, Virginia 23062.

information has been obtained on the distribution and abundance of rock crabs compared with blue crabs, on the ratio of male to female rock crabs, on their average size, and whether they are hard, soft or papershells.

Where They Are

Most rock crabs caught in the dredge fishery of Chesapeake Bay are males and may be distinguished from the females by the shape and size of the abdomen or "apron" (Fig. 3). The crabs have been more abundant east of the Chesapeake Bay Bridge Tunnel and are usually found on hard bottom. Above the bridge tunnel, they appeared to be more common on the eastern side of the bay.

Hard crabs have been kept alive and healthy for more than a month at the Institute in indoor tanks supplied with running seawater. Soft crabs have also been produced, particularly during January, when a large percentage of the rock crabs caught have been peelers.

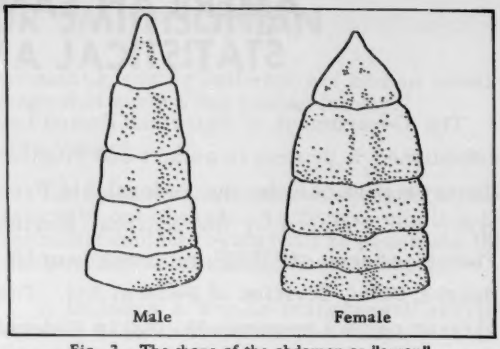
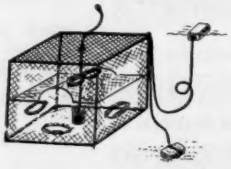


Fig. 3 - The shape of the abdomen or "apron" of the male and female rock crabs.

Soft rock crabs are "fatter" than soft blue crabs--for any given width, rock crabs weigh substantially more than blue crabs. Four- and 5-inch-wide blue crabs may weigh 2 to 4 ounces, whereas the same size rock crabs weigh $4\frac{1}{2}$ to 10 ounces. If sold by weight, soft rock crabs would bring a higher market price than their blue crab counterparts.



AMERICAN SAMOA GETS FISHERY STATISTICAL ANALYSIS PROJECT

The Government of American Samoa has established a project to collect and monitor fishery statistics under the Federal Aid Program administered by the National Marine Fisheries Service (NMFS), reports Edward E. Hueske, Chief, Division of Federal Aid. The $2\frac{1}{2}$-year project requires $21,000 in Federal funds.

Dr. Stanley N. Swerdloff, Supervisor of Marine Resources, Government of American Samoa, will supervise collection of catch and effort data, and biological data on principal species landed by longline fishery. Data will also be collected on the small inshore subsistence fishery.

Longline Fishery

The longline fishery based at American Samoa, the most important private enterprise, is conducted through the cooperation of U.S. and foreign firms.

In 1968, the two canneries processed 29,000 metric tons of tuna worth about $10.6 million to the fishermen. Nearly 1,000 American Samoans are employed. Tuna canning fosters other businesses, which contribute significantly to the islands' economy.

Monitoring Fishery Revived

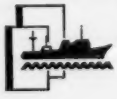
Until recently, the Hawaii Area Fishery Research Center (HAFRC) of the National Marine Fisheries Service maintained a field station at American Samoa to monitor this longline fishery. Its purpose was to assess effect on the important tuna resource of the South Pacific. Budgetary limitations forced discontinuation of its operations at Pago Pago. Under the new arrangement with the Government of American Samoa, HAFRC will be able to continue its work.

Data Collecting Valuable

Despite the large tuna fishery based in Pago Pago, fresh fish appear in the markets only sporadically and in small quantities. The extent of the subsistence fisheries in the villages of American Samoa is not known.

The Government of American Samoa, under the Federal Aid Program, is endeavoring to develop additional fisheries that can be operated wholly by Samoans. Thus, a data-collecting system begun early in this program should produce information vital to effective management of the developing fishery.

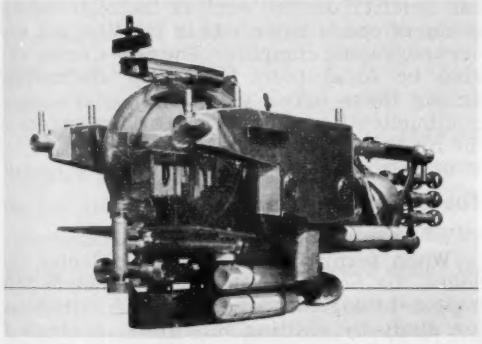
Data on the longline fishery will be forwarded to HAFRC for processing and analysis. This will allow a continuing determination of tuna-resource status in the South Pacific. Data on the subsistence fishery will be processed and analyzed by Dr. Swerdloff.



UNDERSEA RESEARCH VESSEL COMMISSIONED FOR SMITHSONIAN

The Smithsonian Institution commissioned near Ft. Pierce, Fla., in January a 5-man submersible research vessel capable of exploring the ocean at depths of 1,000 feet or more.

The Johnson-Sea-Link, a small acrylic and aluminum diver-carrying vehicle, is named for designer and donors, Edward A. Link, and industrialist J. Seward Johnson. The vessel is capable of staying submerged up to 48 hours.



The Johnson-Sea-Link for exploring ocean depths.

Need for Ocean Study

Smithsonian Secretary S. Dillion Ripley noted at the commissioning that the Johnson-Sea-Link "holds vast potential for the environmental research scientist. . . .

"We now recognize that the integrity of the world's oceans is jeopardized by the same man-created pollution that has so dismally and dangerously affected other aspects of the human environment including many of our inland lakes and waterways. Now more than ever it is critical to study the oceans, so that we may become wiser stewards of a medium that covers two-thirds of the earth, is essential to all life, and holds so much promise in so many ways.

"Our hope is that this technically advanced, submersible link with man's origins will become an invaluable tool in studying the seas around us, adding to the body of human knowledge that serves the human family."

The Vessel

The Smithsonian believes the vessel promises to be one of the most effective small submersible vehicles being built to penetrate the shallow depths of the continental shelf.

It includes a 2-man transparent acrylic sphere, 6 feet in diameter and 4 inches thick. The sphere gives panoramic underwater visibility to a pilot and a scientist-observer. Behind sphere is a separate 3-man, 8-foot-long compartment that will enable 3 scientists to leave from its bottom and collect specimens of flora and fauna.

The 23-foot-long, 18,000-lb. vessel has 6 electric motors that propel it up to four knots. The pilot can scan in all directions through acrylic sphere. This makes it easier for him to hug the bottom and maneuver effectively.

Safety Emphasized

The engineering of the submersible emphasized safety. More than 100 innovations were incorporated. Switches, connectors, and all operating gear were specially designed.

Two divers will operate as a team outside the chamber and a third will remain inside chamber as a safety officer. When the divers are outside, they will be tethered for recovery. Electronic devices will monitor and transmit diver heartbeat and respiration rates to a surface support vessel. A trained physician will always be on duty during dives.

Program for Vessel

At first, the vessel will be used off Florida to study the kinds, populations, and distributions of organisms on the shallow sea floor. Also, it will be used to study freshwater upwelling from Atlantic's bottom. As research program progresses, the craft may be used to study sharks, porpoises, manatees, and the biology of coral reefs.

OCEANOGRAPHY

NOAA ISSUES FIRST MAPS OF FLORIDA'S SEAWARD BOUNDARIES

NOAA's National Ocean Survey has issued 5 maps in a 6-year program to establish Florida's seaward boundaries. Eventually, more than 400 maps will be published covering Florida's east and west seaward boundaries and the Florida Keys.

The first maps cover a 25-square-mile area at False Cape, immediately north of Cape Kennedy, and the Cape Kennedy and Indian River Inlet areas. Seven more maps of these areas will be issued within the next 6 months.

The program specifies mapping the mean low-water and the mean high-water lines along Florida's tidal waters.

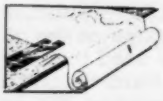
What's At Stake

At stake in the mapping operation is ownership of coastal and offshore lands intermittently covered by the tide. The problem involves determination of U.S., state, and private boundaries.

In coastal areas, the mean high-water line generally marks the boundary between state and private property. In determining limits between U.S. and state ownership, the mean low-water line is the base line, or starting point. Florida claims ownership beginning at mean high-water line and extending offshore 3 miles beyond mean low-water line along Atlantic coast--and to state's historic boundary not over 3 marine leagues along gulf coast.

Where To Get Them

The maps are being published at a scale of 1:10,000 (one inch equals 833 feet). Copies may be purchased for $2.50 each from National Ocean Survey, Distribution Division (C-44), Washington, D.C. 20235.



MARINE SCIENCE CENTER IS DEDICATED IN MIAMI

The $2.1-million Henry L. Doherty Marine Science Center was dedicated on Feb. 26, 1971, at the Virginia Key Campus of the University of Miami's Rosenstiel School of Marine and Atmospheric Science.

"It will be the focal point of the ocean science and industry complex in South Florida, which now constitutes one of the world's major ocean-oriented communities," said Dr. F.G. Walton Smith, Dean of the School. MSC "will serve as a data center where laymen can benefit from the work of the high-caliber group of ocean scientists in the Virginia Key oceanographic complex. The new Center will also be focal point for group discussions among these ocean experts--a place where communication of ideas will strike sparks in the brains of scientists."

The Center

When furnished, the 3-story Center will house the School's library and contain geological-biological data files and collections for study by visiting scientists, students of oceanography, and others. The building will have a computer center, dining room, auditorium, and conference rooms. Residence suites for visiting investigators will be available. Also, there will be educational and service facilities to provide oceanographic information to the public. The building is scheduled to be ready in April 1971.

KILLER WHALES SEEN PURSUING STELLER SEA LIONS

On a recent Bering Sea patrol aboard the USCG Cutter 'Storis', Jim Branson of NMFS Alaska Office of Enforcement and Surveillance, saw a pod of 7 killer whales pursue a band of 20 to 25 Steller sea lions around a Soviet SRTM trawler for over an hour.

Branson reported 9 trawlers operating about 35 miles northwest of Unalaska Island. Each vessel was accompanied by a band of sea lions waiting to feed on fish lost from the trawl as it was hauled.

Whales Pursue Lions

As the Storis came alongside the trawler 'Iskra', a group of killer whales closed in on the sea lions. The latter appeared to panic and clustered alongside the trawler. As the whales moved in, the sea lions dived under the trawler, or swam around the bow or stern seeking safety on the other side. The whales followed but did not attack as long as the sea lions remained tightly grouped. After about 20 minutes, two whales leaped clear of the water and charged the sea lions. A small group of sea lions split from the main group, and one was taken. The whales approached again and again to within a few feet of the trawler and the cutter.

The Storis observed the SRTM's trawling operation for an hour and then departed. The killer whales were still harassing the sea lions, which had become very tired.

DECADES-OLD OCEAN DATA MAY BE A CLUE TO TODAY'S POLLUTION

Oceanographic data collected up to 20 years ago from U.S., Canal Zone, and Puerto Rican coastal waters as part of defense planning will help provide scientists today "with a base on which to determine whether or not significant pollution has invaded these waters," Rear Admiral W.W. Behrens Jr., Oceanographer of the Navy, has disclosed.

The data, which depict the ecology of waters in 13 major harbors and their seaward approaches, have been turned over to NOAA's National Oceanographic Data Center (NODC).

The Data

The data include analyses of the waters' plankton content, temperature, current flow, and salt, sediment and mineral content, and topography.

The East Coast harbor areas covered ranged from Penobscot Bay, Maine, through Mayport, Fla., to the Atlantic side of the Panama Canal. The Pacific areas spanned the West Coast from the Canal Zone to Puget Sound.

The data included similar collections from Navy-funded surveys by scientists of the National Ocean Survey (formerly U.S. Coast and Geodetic Survey), and by contract oceanographers.

FPC: THE NMFS EXPERIMENT & DEMONSTRATION PLANT PROCESS

Robert C. Ernst Jr.

The National Marine Fisheries Service (NMFS) has constructed an experiment and demonstration plant at Aberdeen, Washington,[1/] as part of a research and development program to demonstrate the feasibility of producing and using fish protein concentrate (FPC). The plant was constructed under Public Law 89-701[2/] for about $2 million.

This 'semi-works plant' (less than commercial size) was built to demonstrate an isopropyl-alcohol extraction process and to produce sufficient quantities of FPC for utilization studies by U.S. industry and the Agency for International Development.

The plant was designed, constructed, and is being operated under contract by Ocean Harvesters, Inc., a joint enterprise of SWECO, Inc., Los Angeles, Calif., and Star-Kist Foods, Inc., Terminal Island, Calif.

FISH PROTEIN CONCENTRATE

The basic concept of FPC derives technically and logically from a need to utilize our fishery resources more economically and efficiently as a source of animal protein for human nutrition. FPC is the term used for a broad class of nutritious fish products that can be used in human foods.[3/] These concentrates are primarily animal protein and are characterized by high nutritional quality and stability under a wide range of storage conditions. Variations in processing methods may result in products with many different organoleptic (determined by subjective testing: odor, flavor) and physical characteristics. The concentrates, for example, may be liquids, pastes, or powders. Also, they may be completely odorless and tasteless--or be highly flavorful with cheese or meatlike flavors.

MANY FPC PROCESSES POSSIBLE

Many processing methods[4/] may be used to produce FPCs: some are chemical or biological hydrolysis; protein isolation by extraction and precipitation; vacuum drying and extraction; cooking, pressing, drying, and extraction; and dehydration and extraction with solvents. Whatever method is used, the object is to obtain a concentrated, stabilized form of high-quality animal protein either by isolation of the protein or adequate removal of water, lipids, and any other components considered undesirable in the final product.

DEMONSTRATION PLANT & PROCESS

The process used in the demonstration plant design is a multistage, continuous flow, countercurrent extraction of fresh, ground, whole fish with 91% by volume isopropyl alcohol. The design is based on research and development by NMFS[3/] and by subcontractors[5,6/]. Since the plant will be operated for a very limited period, about two years, many compromises were made to lower capital costs at expense of operating costs. The plant is designed to process up to 50 tons of whole fish per day into 7½ tons of FPC that will meet the standards approved by the U.S. Food and Drug Administration[7/].

Mr. Ernst is Research Chemical Engineer, National Center for Fish Protein Concentrate, National Marine Fisheries Service, College Park, Maryland 20740.

COMMERCIAL FISHERIES REVIEW
Reprint No. 902

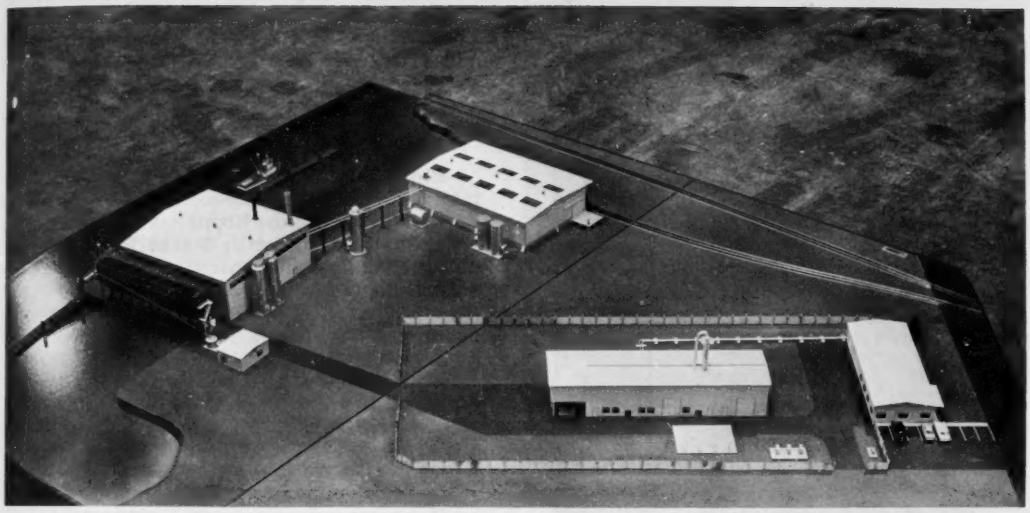


Fig. 1 - Model of Experiment & Demonstration Plant shown in relation to Port of Grays Harbor dock (Washington State) and former Pacific Protein facilities.

In the process, fresh fish are ground and extracted with azeotropic isopropyl alcohol to remove water and lipids. Extraction is performed in a 4-stage countercurrent series of mixing tanks and separating operations, using screens and presses. The extracted solids are desolventized, milled, and bagged, producing FPC. Oil is separated from the extract, and solvent is recovered by distillation for re-use. The following is a step-by-step description of the processing operation.

Unloading

Fresh fish received by boat at the plant are first inspected to see that they meet food quality standards. Then the fish are unloaded by a vacuum, fish-unloading system, which was part of the former Pacific Protein Plant. The system has a capacity of 75 tons of fish per hour. The fish are drained, washed, and conveyed from the fish pump to a calibrated volumetric fish meter. Then the fish are conveyed to the chilled brine-storage system.

Brine Storage of Fish

One hundred and fifty tons of fresh fish can be stored at 32° F in the chilled brine-storage system. This will sustain continuous plant operation up to 3 days. The storage tank is

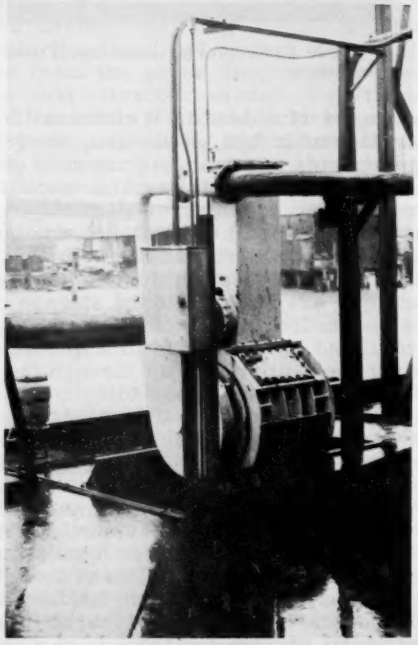


Fig. 2 - Fish are unloaded from holds of boats by fish pump operating on vacuum principle.

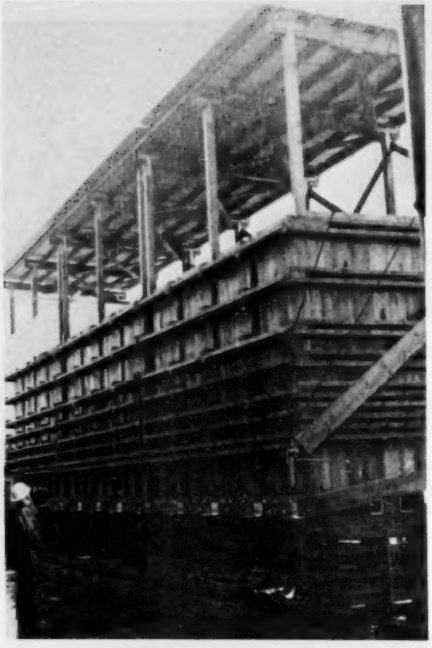


Fig. 3 - Fish can be stored for several days in these redwood tanks.

constructed of redwood. It contains 12 separate, 750-cubic foot, galvanized, steel-lined compartments, each with a capacity of 12.5 tons of fish. The refrigeration capacity is approximately 100 tons. The storage tanks are partly filled with prechilled brine before being charged with fish to obtain more rapid chilling and to reduce physical damage to the fish. Fish are loaded into the storage tanks by deflection from a belt conveyor. The brine is circulated continually from a settling tank through the chiller and up through the fish. Brine quality is checked periodically by NMFS Support Laboratory to maintain a low-solids content and low-bacterial count. An automatic brine make-up system supplies brine from fresh potable water and salt. No bactericides or inhibitors are used in the brine. When plant demands fish, a compartment of fish is drained of brine, and the fish discharged by gravity into 260-gallon, galvanized steel, drop-bottom, tote bins each holding about 2,000 pounds of fish. The bins of fish are transported by fork-lift truck to processing building, where the exact net weight of fish is determined on a platform scale. Then the fish are unloaded onto a conveyor-elevator and are washed with fresh water to remove any adherent brine.

Comminution and Slurrying

Fish from the conveyor-elevator--a 24-inch-wide, inclined, cleated rubber, belt conveyor--are fed to the hopper of a screw feeder 18 inches in diameter by 6 feet long. Comminution (reduction to minute particles) is accomplished in a 40-h.p. Reitz inclined disintegrator using an 18-inch screen with $\frac{1}{4}$-inch openings. The screw feeder is controlled by a current meter on the disintegrator. A reversible screw conveyor from the disintegrator discharges to either of two 1,000-gallon slurry mix tanks, where the ground fish is mixed with a controlled amount of miscella (M-2) from the second stage of extraction. The mix tanks are equipped with 10 h.p., 125-rpm turbine-type agitators, and each contains 4 removable baffles. Associated with each tank is a 10-h.p. centrifugal pump for transfer or recirculation of the slurry.

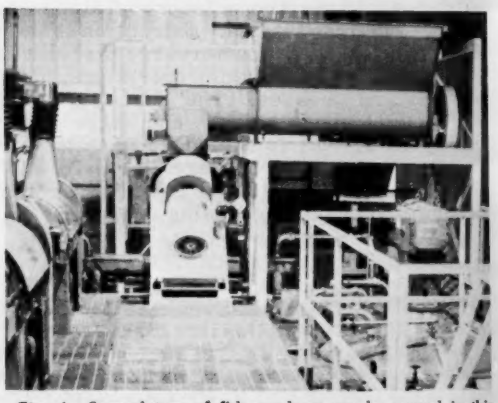


Fig. 4 - Several tons of fish per hour can be ground in this large comminutor.

The fish can be deboned, if desired, by processing through a Zebarth Beehive deboning machine. In this case, fish are fed to the deboner from the disintegator and then pumped to the slurry mix tanks.

Batching of the feed slurry (comminuted fish and miscella M-2) permits periodic shutdown of the disintegrator for cleaning, replacing screen, or other servicing without

interrupting continuous flow of extraction system. Over an hour of down time can be available at design capacity (50 tons of fish per day).

Extraction

Batches of fish and M-2 slurries are prepared and pumped intermittently to the 1,500-gallon feed tank or first-stage mixing tank. Flow of slurry from the tank is maintained constant and marks beginning of continuous extraction system. The first-stage mixing tank contains a level indicator and alarm, but the level must be maintained manually. Suspension of the slurry is maintained by a turbine-type agitator driven by a 10-h.p. motor. The mixing vessel is jacketed, and the temperature of the slurry can be automatically controlled up to 180° F. Present operating conditions, however, specify no heat addition beyond that introduced by the warm miscella (M-2) for this first stage of extraction. Normal operating temperature should be approximately 120° F. The slurry is pumped from the first-stage mixing tank to a SWECO Separator (60-inch diameter, 200-mesh vibrating screen) for primary separation of solids from miscella. Discharge rates from the tank are maintained by manual control of a 2-h.p. variable-speed rotary pump and establish the feed rate to the extraction system. The design rate is about 30 gallons per minute.

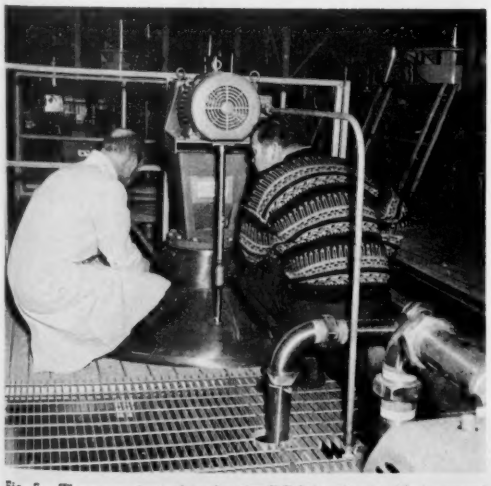


Fig. 5 - The comminuted (pulverized) fish is mixed with isopropyl alcohol in large slurry tanks.

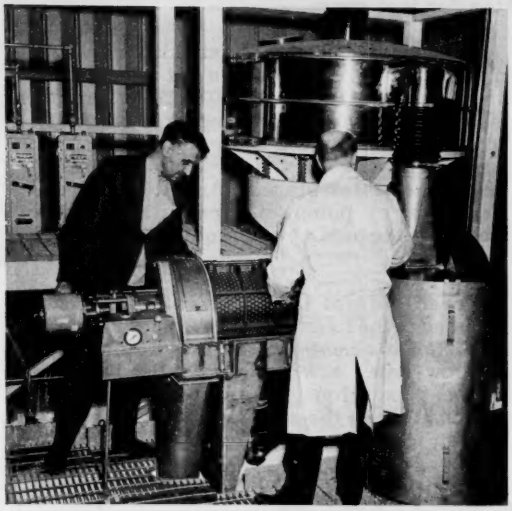


Fig. 6 - The protein portion of fish slurry is separated from this miscella in a series of shaker screens and pulp presses. The top of pulp press has been removed for inspection.

The solids from the screen discharge to a Brown International Pulp Press, which reduces further the liquid content of the solids. Solids from the press discharge by gravity to the next extraction vessel. Volatile content of the solids from this first-stage press are approximately 60%. Lipids content of the solids, when using a 2:1 overall alcohol to fish ratio, are about 4% on a dry basis. The liquid effluents from the press and screen are combined and referred to as first-stage miscella (M-1). This miscella is pumped to a 300-gallon vessel and processed further to recover solvents and by-products. The feed tank, pump, screen, and press constitute the first stage of extraction.

Solids from the first stage of extraction are mixed with miscella (M-3) from the third stage of extraction in the second-stage, 800-gallon, agitated, jacketed vessel. Temperature is maintained automatically at 165° F. Slurry flow from this vessel is controlled manually, but it is constant once the system is operating under steady-state conditions. The tank level is indicated and changes must be compensated by manual control of the discharge pump. The level in any of the extractors and the discharge flow rate establish an average residence time or extraction time. The extraction time can be altered by changing the operating level. A 600-gallon level

results in an extraction time of about 20 minutes for that stage.

At present, 4 stages of extraction are used in the system. The equipment used in the 4 stages are similar. A 1,500-gallon extraction vessel and a 60-inch-diameter vibrating screen are used in the first stage; 800-gallon extraction vessels and 48-inch screens are used in the 3 later stages. An extraction vessel, a slurry pump, a screen, and a press constitute the basic equipment for an extraction stage.

Fresh solvent (new or reclaimed) is introduced to the fourth or last stage of extraction through a heat exchanger. Temperature and flow rates are automatically controlled to preset conditions. The solvent rate is commensurate with the solvent ratio desired and the fish feed rate to the first stage.

Desolventizing

Desolventization of the solvent wet solids is accomplished by introducing steam countercurrently to the solids in a Strong-Scott Solidaire Processor Model SJS 24-16, followed by final redrying and conditioning of the solids in additional units. Four units 16 feet long and 24 inches in diameter are used in series. Final moisture is controlled below 9% and residual alcohol below 250 parts per million. Uncondensed steam and volatilized solvent are condensed and sent to solvent recovery. The desolventized solids are conveyed to the milling room in a 6-inch screw converyor.

Milling and Bagging

The dry solids from desolventizing are received in the hopper of a variable-speed screw feeder to the mill. The mill is a Pulverizing Machinery Company Model 60 ACM mill driven by a 75-h.p. motor. The solids are milled to pass 200 mesh, then received in a Micro-Pulsaire bag collector; they are bagged in 50-pound, polyethylene-lined, multiwall paper bags. After check-weighing and sealing, the bags are palletized

Fig. 8 - The solvent is recovered by distillation in 54-foot tower that extends above roof line of plant.

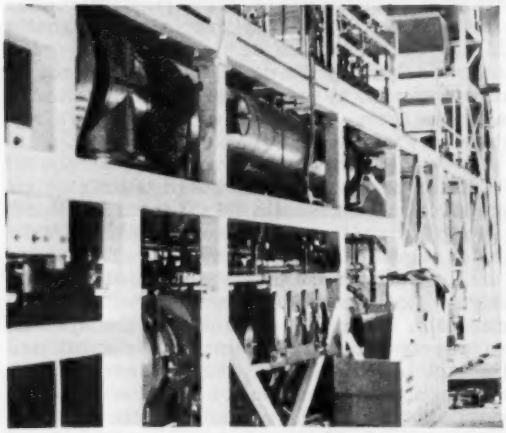


Fig. 7 - The wet solids are desolventized in a series of 4 large steam-heated drying units. The equipment is arranged compactly in a steel framework designed to facilitate transport from its fabrication point in Los Angeles, Calif.

Fig. 9 - Pulverized FPC is milled and bagged in a separate room.

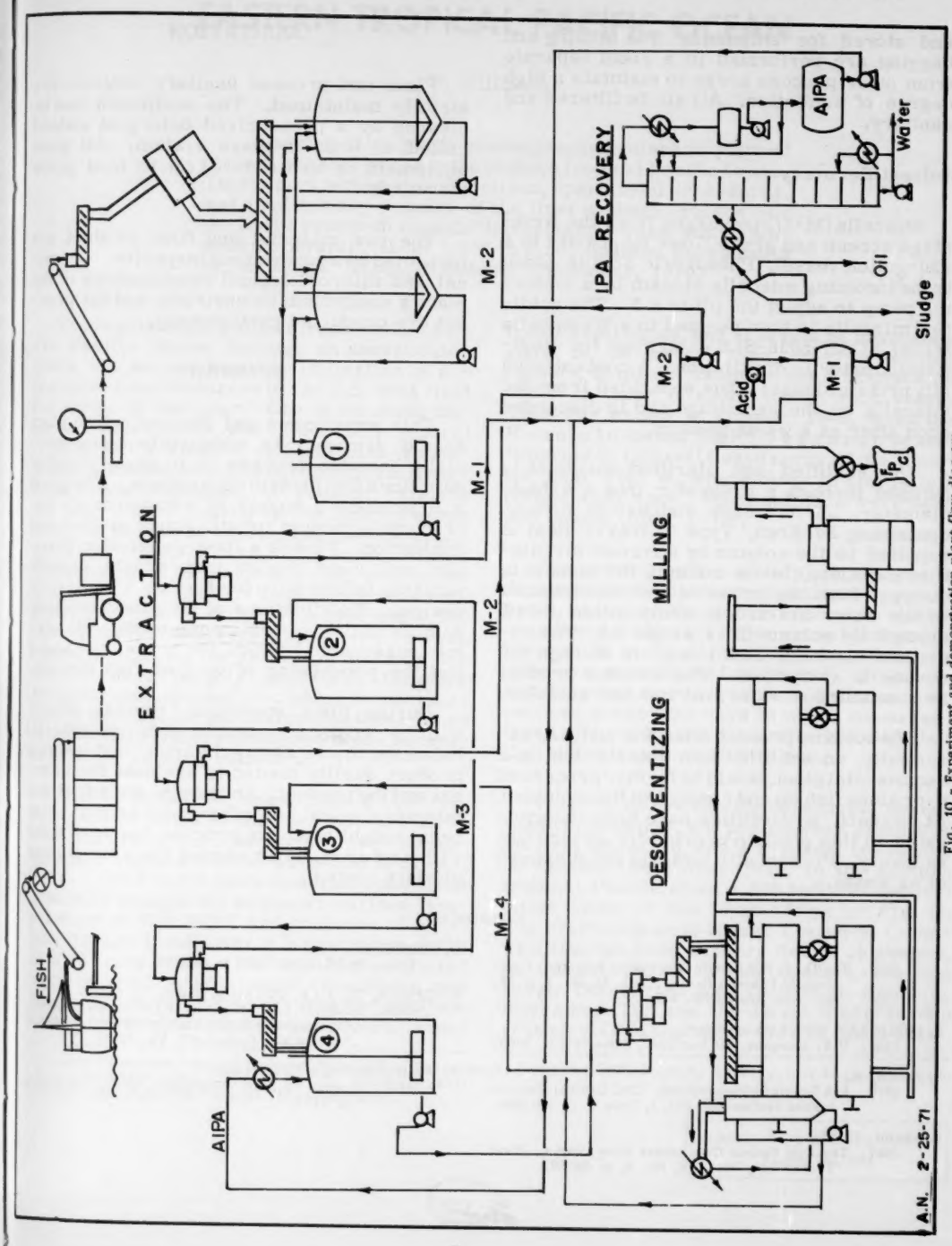


Fig. 10 - Experiment and demonstration plant flow diagram.

and stored for shipment. The milling and bagging are performed in a room separate from other process areas to maintain a high degree of sanitation. All air is filtered and sanitary.

Solvent Recovery

Miscella (M-1) discharged from the first-stage screen and press flows by gravity to a 250-gallon vessel. Phosphoric acid is added to the incoming miscella stream by a metering pump to adjust the pH to 4.5. The acidified miscella is then pumped to a Westphalia Model SOAH-5036-SLS centrifuge for clarification prior to distillation. A concentrated oily protein sludge is thus separated from the miscella by the centrifuge and is discarded soon after as a waste product.

The acidified and clarified miscella is pumped through a preheater into a 4-foot-diameter, 54-foot-high distillation column containing 24 Koch, Type T trays. Heat is supplied to the column by a forced-circulation reboiler. In the column, the alcohol is stripped from the miscella and concentrated to the water azeotropic composition of 91% alcohol by volume (87.7 weight %). The reclaimed alcohol is sent to solvent storage for re-use in extraction. The bottoms product is a mixture of water, oil and fish solubles.

The bottoms product from the still is, essentially, an acidified fish water which, in a commercial plant, would be further processed to produce fish oil and condensed fish solubles. At present, no facilities have been incorporated in this plant to provide for by-product recovery. Present still bottoms are disposed of as waste.

SANITATION

Plant and process sanitary controls are strictly maintained. The equipment can be cleaned by a pressurized detergent method called a clean-in-place system. All plant equipment is constructed to food-grade standards.

The raw material and final product are inspected by a government inspector. Chemical and microbiological examinations of the plant's equipment, its environs, and the product are conducted continuously.

SUMMARY

This experiment and demonstration plant should demonstrate adequately a commercially feasible process to produce a highly nutritious fish protein concentrate. The plant will produce a supply of commercially reproducible product for utilization studies and evaluation. This is a first-generation process and plant design that should provide valuable information for further commercial designs. Modifications of the plant, together with flexibility of basic equipment, will permit reasonable latitude for process changes and the processing of various fish species.

During plant operation, special efforts will be made to acquire data on material balances, operating factors, and related product quality needed to evaluate the process and the product. An on-site chemical and microbiological laboratory capability has been established to provide the operators with information needed for process and product control.

REFERENCES

1. FINCH, R.
   1969. The U. S. Fish Protein Concentrate Program. Commercial Fisheries Review, Vol. 31, No. 1, p. 25-30. Also Reprint No. 832.

2. PUBLIC LAW 89-701 (as amended)
   1966. U.S. Congress, 80 Stat 1089, November 2, 1966.

3. FINCH, R.
   1970. Fish Protein for Human Foods, CRC Critical Reviews in Food Technology, Vol. 1, Issue 4, p. 519-580.

4. KNOBL, G. M., Jr.
   1967. The Fish Protein Concentrate Story, Part 4. Food Technology, Vol., 21, No. 8, p. 56-59.

5. MEINKE, W. W.
   1968. Unpublished report to SWECO, Inc.

6. CIPRIOS, G., D. P. COTRUPE, and P. W. ALLEN
   1969. Studies for the Purification of Isopropyl Alcohol, Clearinghouse for Federal Scientific & Technical Information, Springfield, Va. 22151.

7. Whole Fish Protein Concentrate
   1967. Federal Register, Washington, D.C., February 2, p. 1173.

CURRENT SKIPJACK OCEANOGRAPHY CRUISES IN EASTERN TROPICAL PACIFIC OCEAN

F. Williams

A series of skipjack oceanography cruises is planned for two offshore areas in the eastern tropical Pacific Ocean. This report reviews the objectives, operational procedures, and preliminary results of the first of these cruises--by the NMFS research vessels 'David Starr Jordan' and 'Townsend Cromwell', about 1,100 to 2,500 nautical miles south of San Diego, Calif., in October-December, 1970.

The regulation of yellowfin tuna in the eastern Pacific Ocean, through an annual catch quota, has necessitated the utilization of alternative tuna resources by the U.S. tuna fleet for much of the year. One of the most important alternatives, and in the same general region, is the stock of skipjack tuna (Katsuwonus pelamis), which is unregulated and currently underexploited. At present, skipjack are only fished heavily in the inshore areas along the American coasts, but they certainly occur offshore. Indeed, U.S. purse seiners fishing north of the Equator to the west of the boundary of the IATTC* regulatory area took about 900 tons of skipjack in 1969 and 6,300 tons in 1970. However, these vessels were fishing primarily for yellowfin, and skipjack catches were largely incidental. Offshore skipjack are expected to contain a considerable proportion larger in size than those taken in the inshore fishery and hence more acceptable to the canning industry.

THE EASTROPAC expedition of 1967-68, for which the National Marine Fisheries Service (NMFS) was the lead agency, gave oceanographic results (Love, 1970 and in prep.). These indicated environmental conditions generally suitable for skipjack: surface temperature at 20°-29° C and presence of skipjack forage (food) over a large region north of 5° S from 100° to 130° W. More detailed work on EASTROPAC data (Blackburn and Laurs, in press) has shown that the skipjack forage was concentrated in several zonal (east-west) bands, and at levels of abundance equal to, or greater than, those in existing inshore skipjack fishing areas. Skipjack do occur in these offshore forage-rich zones. This was shown in October 1969, when the Honolulu-based NMFS research vessel 'Charles H. Gilbert' fished north of the Equator near 120° W, where there is normally a forage-rich zone. Many skipjack were seen and caught (Hida, 1970).

The current series of skipjack cruises is designed for detailed investigations, on a seasonal basis, of the occurrence and relative abundance of skipjack in two areas (designated 'A' and 'B' in Fig. 1) of offshore waters considered most suitable for skipjack. To understand their occurrence in such offshore areas, we need to know the ways in which ocean features and conditions determine the distribution and migrations of skipjack.

This report reviews the objectives, operational procedures, and preliminary results of the first cruise. It was a 2-vessel operation, in October-December 1970, in the eastern tropical Pacific about 1,100 to 2,300 nautical miles south of San Diego (Area 'A' Fig. 1): The NMFS research vessel Townsend Cromwell (Hawaii Area Fishery Research Center, R. Uchida, NMFS-Cruise Leader), left San Diego October 23 and arrived in Honolulu November 29; and the David Starr Jordan (Fishery-Oceanography Center, La Jolla,

The author is Associate Research Biologist, Scripps Tuna Oceanography Research (STOR) Program, Institute of Marine Resources, Scripps Institution of Oceanography, La Jolla, California 92037.

*IATTC--Inter-American Tropical Tuna Commission.

COMMERCIAL FISHERIES REVIEW
Reprint No. 903

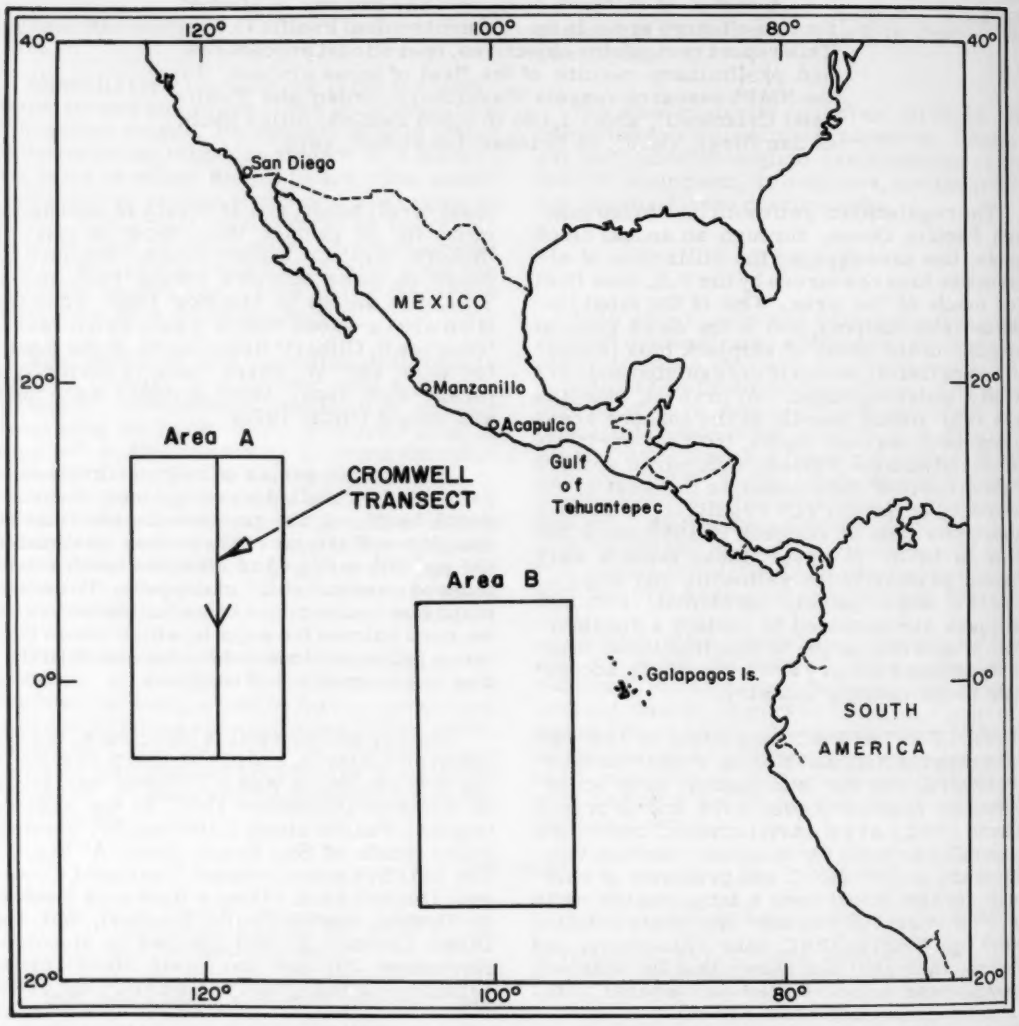


Fig. 1 - Areas of eastern tropical Pacific Ocean under investigation in current series of skipjack oceanography cruises. Also shown is location of oceanographic transect of Area 'A' completed by Cromwell in Part 1 - Operations of first cruise.

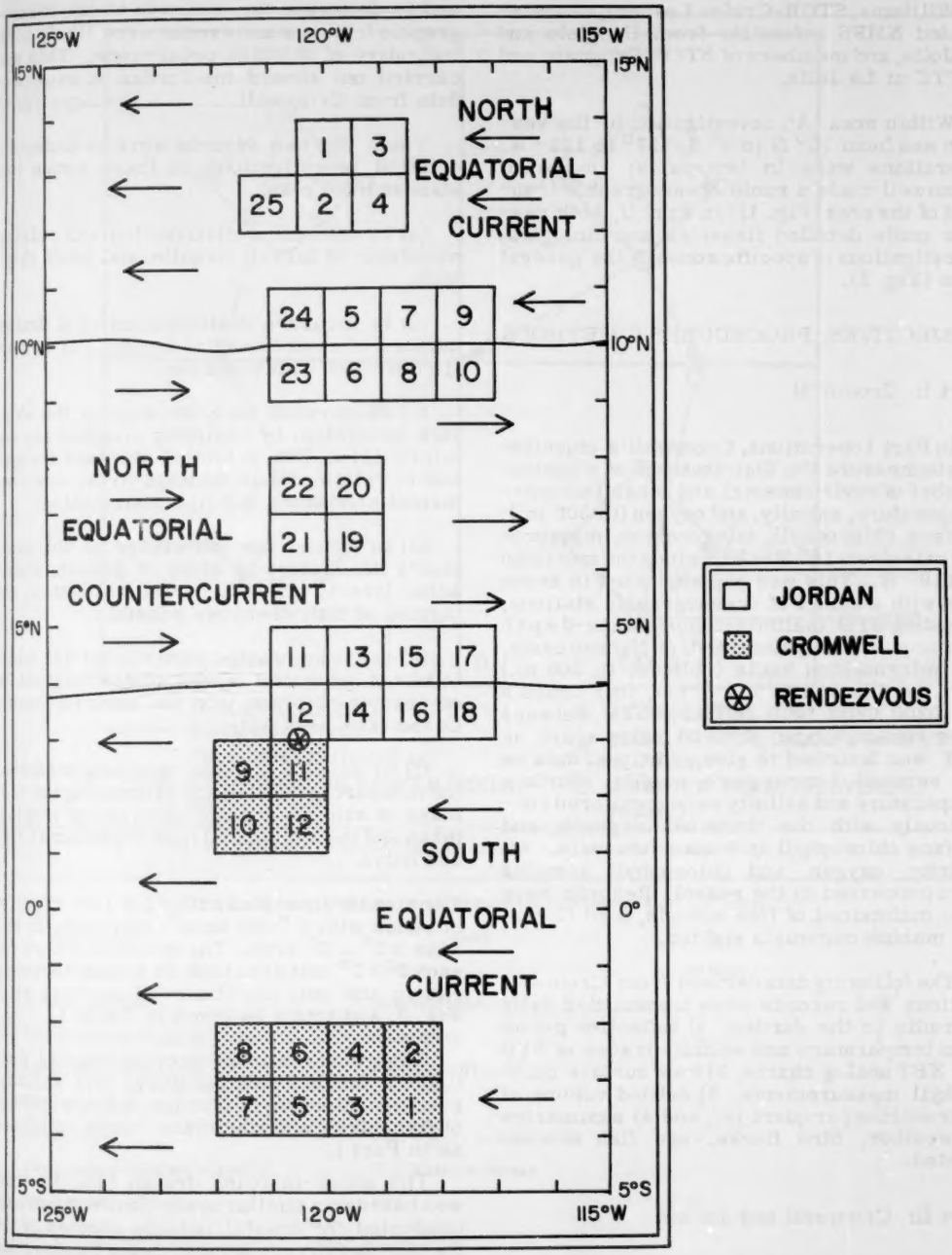


Fig. 2 - Unit areas investigated by Jordan and Cromwell in Part II Operations (first cruise) and relation to surface current systems. Numbers in quadrants of unit areas denote order of occupation by vessels.

F. Williams, STOR-Cruise Leader), which included NMFS scientists from Honolulu and La Jolla, and members of STOR Program and IATTC at La Jolla.

Within area 'A', investigation by the vessels was from 15° N to 5° S, 117° to 122° W. Operations were in two parts: in Part I, Cromwell made a rapid oceanographic transect of the area (Fig. 1); in Part II, both vessels made detailed fisheries and biological investigations of specific zones in the general area (Fig. 2).

OBJECTIVES, PROCEDURES & METHODS

Part I: Cromwell

In Part I operations, Cromwell's objective was to measure the distributions of a limited number of environmental and other factors--temperature, salinity, and oxygen (to 500 m.); surface chlorophyll, micronekton, meteorological--from 15° N to 5° S along the meridian of 119° W. This was accomplished in seven days with a series of oceanographic stations, including STD (salinity-temperature-depth data acquisition system) and/or Nansen casts, and micronekton hauls (oblique, to 200 m.) with the Blackburn 5' x 5' net, four times a day (0200, 0800, 1400, 2000 hr. PST). Between each station, about 45 to 50 miles apart, an XBT was launched to give additional data on the vertical temperature profile. Surface temperature and salinity were monitored continuously with the thermosalinograph, and surface chlorophyll at 3-hour intervals. All salinity, oxygen, and chlorophyll samples were processed on the vessel. Records were also maintained of fish schools, bird flocks, and marine mammals sighted.

The following data derived from Cromwell stations and records were transmitted daily by radio to the Jordan: 1) inflection points from temperature and salinity traces of STD and XBT analog charts, 2) raw surface chlorophyll measurements, 3) settled volume of micronekton per quart jar, and 4) summaries of weather, bird flocks, and fish schools sighted.

Part II: Cromwell and Jordan

In Part II, the first task was to compare results from Part I with historical data for the area, particularly that of EASTROPAC, and to delineate the zones in which oceanographic features and events were likely to be indicative of skipjack occurrence. This was carried out aboard the Jordan on receipt of data from Cromwell.

Then, the two vessels were to undertake detailed investigations in these zones to a standardized plan:

(a) to determine distribution and relative abundance of larval, juvenile, and adult skipjack;

(b) to measure distributions of a limited number of environmental factors (as in Part I) coincident with (a) above;

(c) to increase our knowledge of the skipjack ecosystem by sampling zooplankton and micronekton (for potential skipjack forage) and by relating these findings to the environmental conditions and fish distribution;

(d) to extend our knowledge of the skipjack's life history by study of gonads, stomachs, livers, and other vital statistics; and tagging of fish whenever possible;

(e) to use knowledge gained in (a)-(d) above to test a proposed model of the migrations of recruit skipjack into the eastern Pacific Ocean (see page 34);

(f) to develop a sonar-mapping technique for measuring the size and estimating the biomass of schools and aggregations of tropical tunas and their principal food organisms (Jordan only).

The standardized plan called for investigation of zones with a "unit area" approach, in this case a 2° x 2° area. The scheduled work for each 2° x 2° unit area took 96 hours, including run in and out; the observations were as in Fig. 3, and totals as given in Table 1.

Other observations--meteorological, continuous surface temperature, and salinity; surface chlorophyll (Jordan only); sightings of fish, birds, and mammals--were continued as in Part I.

The sonar-mapping design (Jordan only) was based on a similar study (Smith, in press) conducted for coastal pelagic species of the California Current Region. In particular, this entails determining the range and school size dependence on numbers of sonar targets per unit area.

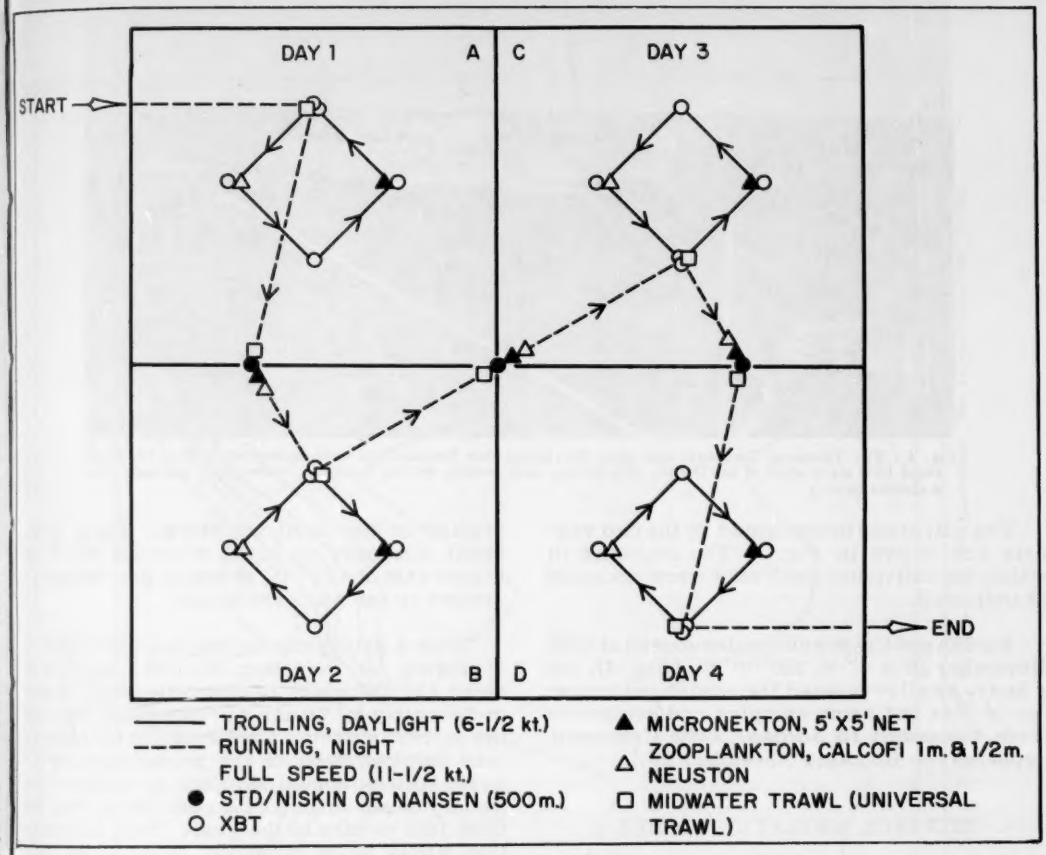


Fig. 3 - Track and scheduled observations for 2° x 2° unit area investigations.

Table 1 - Number of observations scheduled for each unit area (2° x 2° area)

Parameter	Gear	Day	Night
Adult skipjack	Trolling	40 hours	-
Juvenile skipjack	Midwater trawl	-	7[a]
Larval/juvenile skipjack	Neuston net	4	3
Larval/juvenile skipjack	1 m. CalCOFI net[b]	4	3
Micronekton	5' x 5' net	4	3
Zooplankton	1 m. & ½ m. CalCOFI nets	4	3
Temperature, salinity, oxygen[c]	STD/Niskin or Nansen	-	3
Temperature	XBT	20	-

[a] 4 hauls occupied equal time either side of marine dawn.
[b] Same hauls as for zooplankton.
[c] No salinity or oxygen samples were obtained during Part II on Cromwell due to elimination of Nansen casts.

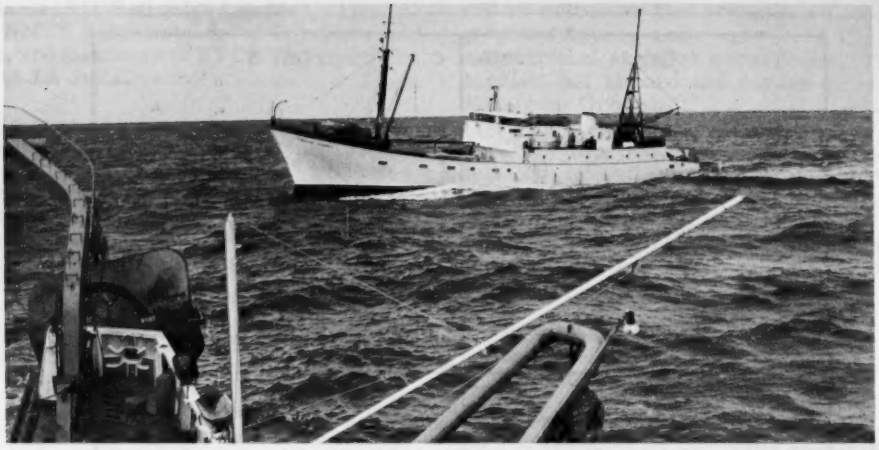


Fig. 4 - RV. Townsend Cromwell seen from RV. David Starr Jordan at high-seas rendezvous on Nov. 19, 1970, about 1800 miles south of San Diego. (On Jordan, note portside trolling outrigger, white pole, and door for midwater trawl.)

The unit areas investigated by the two vessels are shown in Fig. 2. The sequence in which the individual quadrants were occupied is indicated.

Jordan and Cromwell rendezvoused at 0900 November 19 at 3° N, 120°30' W. (Fig. 4), but a heavy swell prevented the envisaged transfer of data and some samples and equipment from Cromwell to Jordan. (The Cromwell departed for Honolulu November 20.)

SKIPJACK MIGRATION MODEL

The adolescent (sexually immature) fish, which form the bulk of the skipjack catch in the eastern Pacific, are considered to have a central Pacific origin (Rothschild, 1965). Any model of the migration of the juvenile skipjack (< 35 cm) eastwards must account for the separation into the northern stock (Acapulco to California) and the southern stock (eastern Gulf of Tehuantepec to northern Chile).

The proposed migration model of Williams (in preparation) indicates that changes in flow of surface North Equatorial Countercurrent (NECC), due to seasonal changes in position of Inter-tropical Convergence Zone (ITCZ)--the meteorological equator--are responsible for north-south split of incoming recruit skipjack. When NECC eastward flow is continuous to Central America coast from May/June to December/January, skipjack are being recruited to the southern stock. Then, from about February to April, when the NECC is absent east of 120° W, skipjack are being recruited to the northern stock.

Thus a gating mechanism is considered as operating on incoming recruit skipjack at about 120° W, which is controlled by a major meteorological feature--the ITCZ-through the current system. Confirmation of this may lead to prediction of the percentage north-south split of annual skipjack recruits to the fishery based on the ITCZ position during the first four months of the year. Such information would be of strategic value to the tuna industry and to those studying skipjack population dynamics.

Testing this migration model is necessary if the oceanographic monitoring and forecasting system (presently for U.S. west coast albacore fishery) of NMFS Fishery-Oceanography Center, La Jolla, now being extended to tropical tunas, is to have predictive value for skipjack.

PRELIMINARY RESULTS

Part I: Oceanographic Transect

Preliminary analyses show the distribution of temperature (Fig. 5) and salinity was generally similar to that observed at the same meridian, 119° W, in late October, 1967, during EASTROPAC. The lowest surface

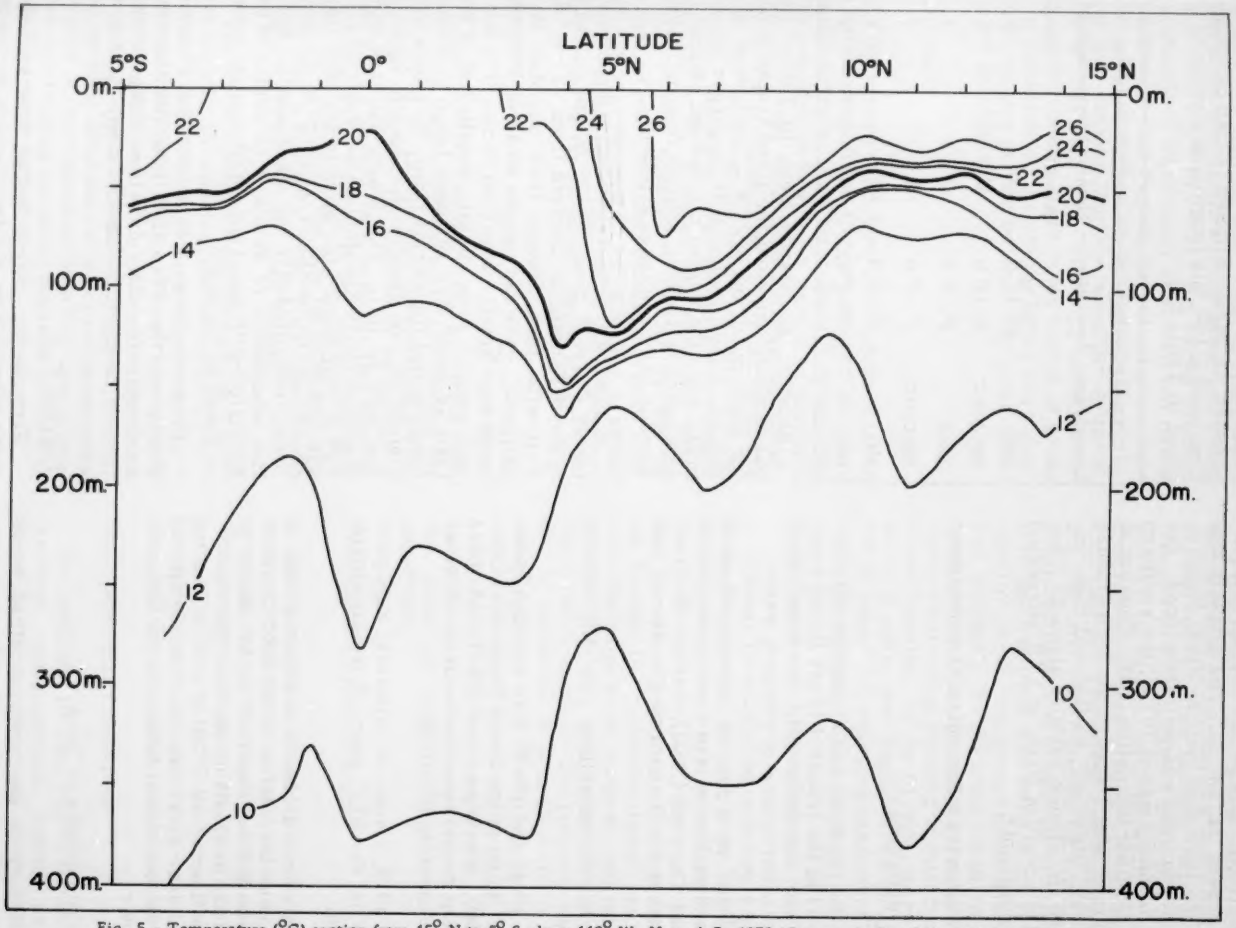


Fig. 5 - Temperature (°C) section from 15° N to 5° S along 119° W, Nov. 1-7, 1970 (Cromwell, Part I Operations--first cruise).

temperature, 20° C, was observed in the South Equatorial Current at 1° S, and the lowest surface salinity, 32.9‰, in the North Equatorial Current at 13° N. The slope of the thermocline indicated that the North Equatorial Countercurrent was well developed: the northern boundary was at 10° N, the southern at 4° N. No clear indication of the Equatorial Undercurrent was found in the temperature distribution. However, an isolated high-salinity core (maximum salinity about 35.2‰, centered at a depth of 50 m. at 1° S, suggested the Undercurrent).

Part II: Fisheries & Biological Observations

Zones Investigated

From the physical and biological data obtained during the transect (Part I) and comparison with historical data, the most likely zones for occurrences of skipjack were:

1) 12°-14° N, a zone of high micronekton catches and shallow mixed layer in the North Equatorial Current (NEC), but not far from the surface North Equatorial Countercurrent (NECC);

2) 9°-11° N, straddling the NEC-NECC boundary;

3) 3°-5° N and 1°-3° N in the high "productivity" band of the South Equatorial Current (SEC), between the NECC southern boundary and cold upwelled equatorial water (at approximately 0°30' N);

4) 2°-4° S, a zone of relatively high productivity in the SEC south of the equatorial upwelling.

It was decided also to examine a zone at 6°-8° N near the center of the NECC, where skipjack might be expected to be absent or present only in small numbers. The equatorial zone from about 0°30' N to 2° S was not examined because near-surface temperatures were considered rather low for skipjack occurrence.

Relative Abundance of Tuna

Trolling time averaged about 10 hours per day at 6½ knots; the effort in each zone was 4-8 days. Skipjack and yellowfin tuna were the principal species caught (boarded, tagged, or lost but identified). Relative abundance of tuna in 2° latitude zones--expressed as mean-number of fish caught per line-hour x 10^3, all longitudes combined--is given in Table 2.

Table 2 - Relative abundance of troll caught tuna

Current System	Zone Latitude	Mean catch per line-hour x 10^3	
		Skipjack	Yellowfin
NEC	12°-14° N	52	34
NEC/NECC	9°-11° N	39	11
NECC	6°- 8° N	43	2
NECC/SEC	3°- 5° N	115	8
SEC	1°- 3° N	196	0
SEC	2°- 4° S	82	0

Relative abundance data in Table 2 are based on catches along the fixed tracks shown for each quadrant of 2° x 2° unit areas (see Fig. 2). They do not include the larger catches made when the vessel circled and chummed, with anchovy live bait, schools from which fish already had been taken trolling.

Skipjack were most abundant in South Equatorial Current from 1°-3° N, and yellowfin in North Equatorial Current from 12°-14° N. Yellowfin tuna, always less abundant than skipjack, were not caught south of 3° N, and most were small--less than 35 cm. The skipjack caught were mainly smaller or larger than average size of those taken in inshore commercial fishery off U.S.: they were less than 40 cm., or greater than 55 cm. (up to 71 cm. and 20 lb.). The small skipjack were mainly in North Equatorial Current from 12°-14° N, but some also were in the NEC from 10°-11° N and the SEC from 3°-4° N; the large ones predominated in the other zones. Relative abundance of skipjack in center of the NECC (6°-8° N zone) appeared similar to that in zones to the north.

First results show that for 2° or 1° latitudinal zones there is a significant positive correlation (probability at 5% level) between surface chlorophyll levels and skipjack relative abundance.

Tagging

Sixty-seven skipjack and four yellowfin were tagged from the two vessels during the cruise.

Fish Schools, Bird Flocks, Marine Mammals

Very few tuna or other fish schools were seen at the surface in survey area, and these were restricted to 7°-11° N. Birds (flocked or unflocked) were most common, but never abundant, in this region; porpoises were seldom seen. However, on passage to Honolulu, and just outside survey area (6°-8°40' N, 128°30'-133° W), the Cromwell encountered on two successive days many flocks of birds over fish schools. Few of the latter were identified, but one or two on each day were noted as 4-8 lb. skipjack.

Live Bait

Fifty scoops of anchovy live bait were taken aboard Jordan in San Diego and used as chum on tuna schools. And, on at least 3 occasions, this resulted in keeping a school of skipjack near the vessel's stern and increasing considerably the troll catches. Fish had taken the live bait as shown by fresh anchovies in the stomach contents. The anchovy were taken on board in 17° C water and withstood water temperatures exceeding 29° C during the cruise. Those not used remained in good condition when released in 19° C water near the end of the cruise. They were fed a proprietary brand of "trout chow" twice a day.

Behavior of Tuna

On several occasions, small groups of tuna were seen swimming ahead of the Jordan for several hours. On one day, observations from the bow chamber indicated the presence of both yellowfin and skipjack; on two others, only skipjack. On one of the latter, the fish were sampled from the bow by hook and line using live anchovy bait; four specimens ranged from 60-64 cm. fork length.

The times of skipjack catches on the 2 vessels showed, as expected, the immediate postdawn and predusk periods best for trolling--between 0600 and 0759, 19% of total catch; between 1700 and 1759, 30%. The postdawn percentage probably would have been greater but the 0600-0659 period was poorly sampled because of the transdawn trawling operations. Fish did strike at all other periods of the day but to a lesser extent.

Biology

Fork lengths (cm.) were taken, gonad maturity states noted, and stomach contents preserved for all fish landed. Skipjack ranged from 32 to 71 cm. (about 1-20 lb.) on Jordan, and 37 to 64 cm. on Cromwell. The Jordan data fall into 3 size groups: 32-40 cm. (mean 35.3 cm., n = 17), 45-50 cm. (mean 47.5 cm., n = 11), and 53.71 (mean 59.7.cm., n = 92). Cromwell data tend to indicate similar groups, although numbers are very much fewer, except for 54-60 cm. group (mean 57.3, n = 14). Ten skipjack, 53-68 cm., taken in 3°-5° N zone, were females with recently spent or spent-recovering gonads; of latter category, three females, 46 to 61 cm., were taken in 6°-7° N zone, and four, 59-64 cm., in 10°-11° N zone. All skipjack taken on Cromwell were immature.

Tuna Larvae and Juveniles

Twenty 15-minute neuston hauls were made from Cromwell, and 40 from Jordan. The Jordan samples were sorted on board ship, but these appeared to contain no tuna or billfish larvae or juveniles. On Cromwell 8, and on Jordan 10, midwater-trawl hauls of $1\frac{1}{2}$-hour duration were made around midnight to a depth of 30 m.; and, respectively, 11 and 9 hauls were made to 100 meters, or depth of 20° C isotherm if less than 100 m., spaced equally either side of marine dawn. On Jordan, trawl depth was monitored by telemetry from trawl warp transducers. Her trawl samples were roughly sorted on board; a 17 cm. Auxis (frigate mackerel) was only tuna observed.

Potential Skipjack Forage

Jordan made 42 tows with 5' x 5' net, Cromwell 44, to determine total micronekton and skipjack forage in Part I and II operations. The zooplankton samples from the 1-m. and $\frac{1}{2}$-m. CalCOFI nets, 38 on Jordan and 20 on Cromwell, and all midwater-trawl samples also will be examined in this respect.

Environmental Conditions

In addition to the Part I oceanographic transect, oceanographic conditions will be described for unit areas of Part II. In all,

for Parts I and II, Jordan made 122 XBT drops and 17 STD/Niskin casts; Cromwell made 58 XBT drops and 8 STD/Nansen casts for vertical profiles of temperature, salinity, and oxygen. Nansen casts also were made for STD calibrations.

Acoustic Data

On Jordan, acoustic data were collected on incidence of schools of large-fish targets, single large-fish targets, schools of small fish, and scattering layers. For most of cruise, thermal stratification was so shallow and abrupt that near-surface targets were not detectable with surface-mounted sonars. Single-fish targets were detectable to 150 m. lateral range (30 kHz, 10 m-sec pulse); in November, the incidence ranged from a rate of 180 per day (Nov. 15) down to 6 per day (Nov. 18). Many schools of small fish were detected on the sounder at depths of 260-400 m. On occasion, these schools also were detectable with long-range sonar due to downwelling sound-propagation conditions. The range in these instances was about 2000 m. (11 kHz, 30 m-sec pulse). Major layers were present near thermocline, and at a depth of 350 m. Maximum rates of migration were on the order of 16 cm./sec. vertical motion, with average rates of 6.5 cm./sec. 6 hours before and after local apparent noon. One school of Vinciguerria sp., an important forage species for skipjack, was detected near surface with the 11 kHz sonar at 900 m. range; later, the school was sampled by midwater trawl (15 x 15 m. trawl with 3 mm. bar mesh). No schools of large fish were detected.

Communications

In a two-vessel operation of this type, good radio communications are essential to coordinate efforts. Throughout cruise, Jordan was in contact with Cromwell and NMFS shore station WWD to transfer scientific data, weather, and general messages (CW, voice, teletype). In November alone, Jordan handled 718 messages. Jordan received daily facsimile (FAX) charts of eastern Pacific weather from Fleet Weather Central-Alameda, which included position of the Inter-tropical Convergence Zone. In addition, experiments continued with transmission by FAX of special weather and other charts and data from Fishery-Oceanography Center, La Jolla.

PRELIMINARY RESULTS AND SKIPJACK MIGRATION MODEL

At the time of this first cruise, the NECC was well developed in the area investigated. Recruit size skipjack mainly were caught in the NEC at 12°-14° N and, to a lesser extent, in NEC and SEC immediately adjacent to the NECC. They were not found in the NECC or in the SEC south of the equator. These findings are consistent with the model for this time of year.

FUTURE CRUISES

A second cruise to Area "A" using the Jordan is taking place from March 1 to April 12, 1971. The first cruise to Area "B" is planned for August 16 to October 8, 1971.

ACKNOWLEDGMENTS

I thank my colleagues who participated in the first of the present series of skipjack oceanography cruises, particularly R. Uchida, Cruise Leader on the Townsend Cromwell, and P. Smith and M. Tsuchiya for their comments on acoustic and oceanographic results, respectively.

LITERATURE CITED

BLACKBURN, M. and R. M. LAURS
(in press). Distribution of forage in the eastern tropical Pacific. Nat. Mar. Fish. Serv., Fish. Bull.

HIDA, T. S.
1970. Surface tuna schools located and fished in equatorial eastern Pacific. Com. Fish. Rev. 32(4): 34-37. Also Reprint No. 868.

LOVE, C. M., Ed.
1970. EASTROPAC Atlas, Vol. 4. Biological and nutrient chemistry data from principal participating ships, First and Second Monitor Cruise, April-July, 1967. Nat. Mar. Fish. Serv. Cir. 330 (Volumes 1-3, 5-11 in preparation).

ROTHSCHILD, B. J.
1965. Hypotheses on the origin of exploited skipjack tuna (Katsuwonus pelamis) in the eastern and central Pacific Ocean. U.S. Fish. Wildl. Serv., Spec. Sci. Rep. Fish (512): 20 p.

SMITH, P. E.
(In press). The horizontal dimension and abundance of fish schools in the upper mixed layer as measured by sonar. Int. Symposium on Biol. Scattering, Washington, D. C., 1970.

FACTORS AFFECTING EXVESSEL PRICES OF SKIPJACK TUNA IN HAWAII

Yung C. Shang

The skipjack-tuna industry in Hawaii is the most important segment of the state's commercial fisheries. However, the average annual catch of about 5,000 tons of this industry has remained relatively stable during the past two decades. The available evidence suggests that the lack of growth of this industry is not due to overfishing. On the other hand, the cost-revenue analysis indicates that, given the past input and tuna prices, the profit margins in the industry were too low to induce new investment.* The relatively high cost of inputs is associated with the labor-intensive fishing technique used and the bait problems. The main objective of this paper is to examine the factors affecting the prices of skipjack tuna.

Skipjack tuna vessels in Hawaii can be divided into two major groups: 10 of the vessels based on Oahu are members of the Tuna Boat Owner's Association; 2 others on Oahu, and 4 vessels on the other islands are operated independently.

Two major markets exist for the local catches: the fresh-fish market, and the cannery market. About one-third of the landings is consumed mainly as sashimi (raw fish). The remainder is canned and labeled as Coral Tuna--the only brand in the world canned from fresh tuna (not frozen).

Marketing Channel

The marketing channel varies among the vessel groups and among the markets (Figs. 1 and 2). Vessels belonging to the Tuna Boat Owner's Association utilize the Hawaiian Tuna Packers as the selling agency for fresh fish. The Hawaiian Tuna Packers usually has a representative contact the local wholesalers and wholesalers/retailers about their current needs for fresh fish. The United Fishing Agency acts as a selling agency for the other two vessels on Oahu and usually sells the fresh fish directly to wholesalers, wholesalers/retailers and, occasionally, through auction. The independent vessels on the other islands sell their catch to wholesalers and retailers through their local selling agencies. When the fresh fish market is fully supplied each day, the excess is sold directly by the independent vessels, and the members of the Tuna Boat Owner's Association sell the excess, through Hawaiian Tuna Packers, to the cannery at a set price, which is lower than price at fresh-fish market.

Fresh-Fish Market

The fresh-fish market for skipjack tuna in Honolulu consists of two major sellers, or selling agencies, Hawaiian Tuna Packers and United Fishing Agency, and a number of buyers--wholesalers and wholesalers/retailers. This is a duopolistic market--in which price determination is usually dominated by the sellers. Since the sellers have almost perfect knowledge about the market supply and demand, the price is usually set higher than the price which would be expected in a competitive market. The local fishermen have been receiving higher average prices than those on the U.S. West Coast for 2 reasons: price of fish in the fresh-fish market is much higher than price paid by the cannery, and because fresh-fish market of skipjack is the largest in the United States.

How Exvessel Price Determined

The exvessel price of market fish is assumed to be a function of its quantities supplied to the fresh-fish market, the quantities of yellowfin tuna (a higher-quality substitute for sashimi, raw fish), the quantities of other fresh fish, and the season. However, the results of the regression by using monthly data for 1958-1966 indicate that the quantities of yellowfin tuna and other fishes have no significant statistical effect on the exvessel price of skipjack tuna. The prices of skipjack tuna

The author is an Assistant Economist, Economic Research Center, University of Hawaii.

*Shang, Yung C., The Skipjack Tuna Industry in Hawaii: Some Economic Aspects, University of Hawaii, Economic Research Center, 1969.

are influenced primarily by the quantity supplied and the season.

The quantities supplied to fresh-fish market is a function of total landings in some months of the off-peak fishing season. Since supply is relatively scarce during this period, 100% of total catch is frequently sold to the fresh-fish market. The exvessel prices usually fluctuate with quantity supplied. During the peak fishing season, however, the quantities supplied to the fresh-fish market, which accounts for a small proportion of seasonal catch of skipjack tuna, are at a relatively high level and at a relatively low and stable price.

The market demand for fresh skipjack tuna is not likely to increase significantly in the future because there is no positive significant relationship between the per-capita consumption and the per-capita income. Therefore, the development of this fishing industry relies on the cannery market.

Cannery Market

The skipjack tuna cannery market in the landing level in Hawaii consists of one buyer, Hawaiian Tuna Packers, and a number of sellers--a monopsony market. In this monopsony situation, price determination is usually dominated by the buyer. In the short run, the exvessel prices paid by the local cannery do not fluctuate with the catches. They are set for a longer period. The cannery buys all excess catch at set prices that cannot be absorbed by local fresh-fish market. Therefore, the cannery demand curve is approximately a horizontal line with a perfect elasticity of demand within a certain period.

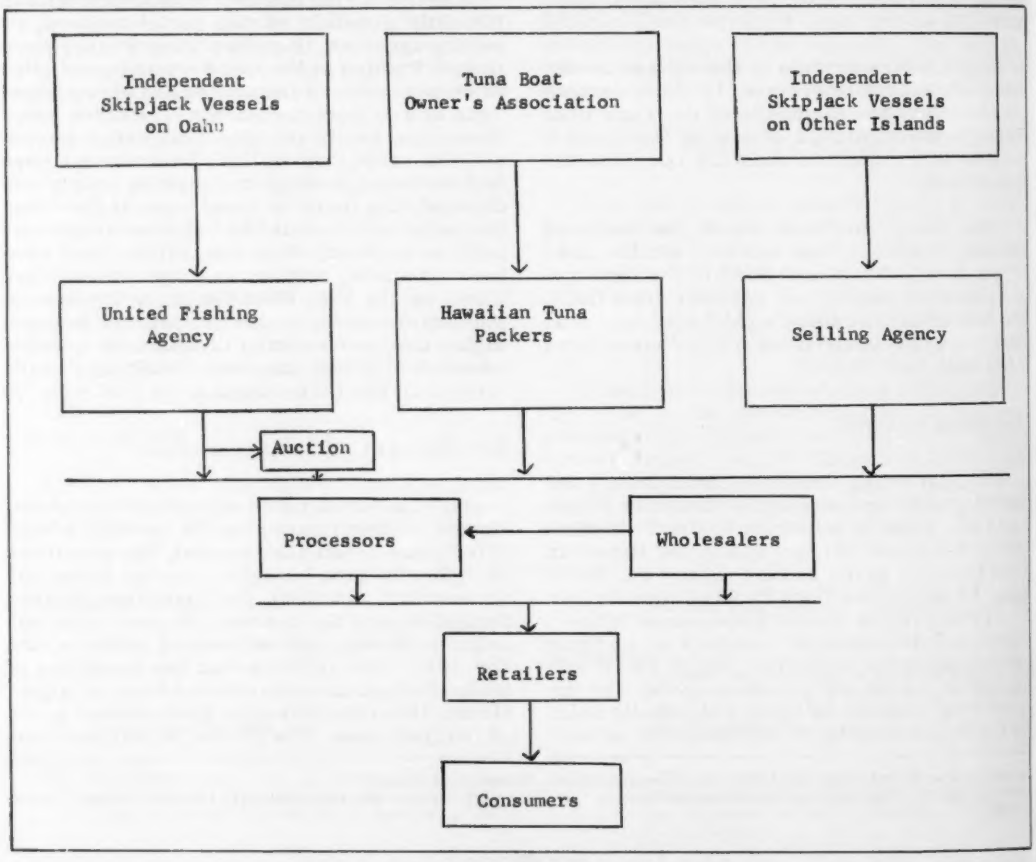


Fig. 1 - Marketing channels to the fresh fish market.

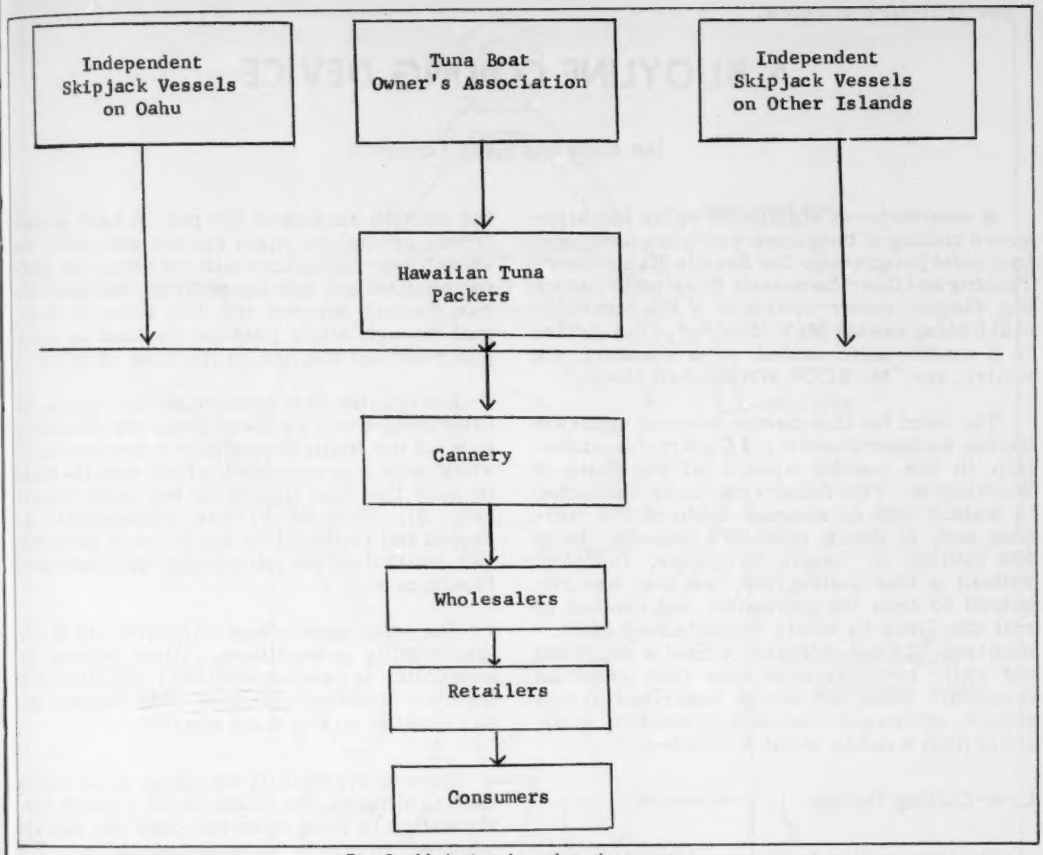


Fig. 2 - Marketing channels to the cannery.

Canned tuna packed from local catches has to compete with the mainland packed tuna in the local and mainland markets. The exvessel price paid by the local cannery does not fluctuate monthly. However, when the average exvessel price of skipjack tuna on the U.S. West Coast increased in recent years, the level of local price paid by the cannery also increased. On the West Coast, the prices of skipjack follow the prices of yellowfin. The coefficient of determination (R^2) of the regression is 0.98. This indicates that these two prices are moving up and down very closely. The difference between these two prices is about $50 per ton.

The exvessel prices of domestic yellowfin is a dominant factor in determining the exvessel price of skipjack tuna on the West Coast. This, in turn, imposes limits on the highest price that can be paid by the local cannery. So local fishermen are not able to increase their profit simply by raising the price of fish to a large extent. The profit should be increased mainly by reduction of costs through improvements in fishing technique.

Acknowledgments

I thank Mr. Tamio Otsu, Hawaii Area Fishery Research Center, National Marine Fisheries Service; Mr. Scott McLeod, Hawaiian Tuna Packers; and the late Professor Vernon E. Brock, University of Hawaii.

GEAR NOTE: With this device, inexperienced man can haul sablefish pot in about 8 minutes.

A BUOYLINE COILING DEVICE

Ian Ellis and Gary Loverich

A new device of significant value for high-speed coiling of buoylines has been developed in a joint program by the Seattle Exploratory Fishing and Gear Research Base and Captain Sig Jaeger, owner-operator of the commercial fishing vessel M/V 'Seattle'. The device is a modification added to a standard pot hauler, the "MARCO* JO105 crab block."

The need for this device became apparent during an experimental pot fishery for sablefish in the coastal waters off the State of Washington. This fishery has been conducted in waters with an average depth of 275 fathoms and, at times, up to 375 fathoms, using 400-fathom or longer buoylines. Initially, without a line-coiling aid, one man was required to tend the pot hauler and another to coil the lines by hand. Experienced fishermen took 12 to 14 minutes to haul a sablefish pot while inexperienced men took about 18 minutes. Using the device described in this report, an inexperienced man working alone could haul a pot in about 8 minutes.

Line-Coiling Device

The line-coiling device consists of a guiding channel that receives and guides the line after a splitter picks it off the main sheave of the block and guides it into a fiber-reinforced rubber discharge hose (Fig. 1). The operator stands facing outboard with his left hand manipulating the hydraulic control for the block, and his right hand directing the discharge hose to place the line in a neat coil at his feet (Fig. 2). A spring-loaded steel finger with a grooved face holds the line tightly in the main sheave when the incoming line is slack (Fig. 3). This steel finger can be easily engaged or disengaged by the operator with his left hand while coiling the line and without interrupting the smooth hauling of the pot. A knot passes freely around the main sheave and under the steel finger. If the knot will not clear the guiding channel and discharge hose, the operator can quickly remove the line from the hose, pull enough slack past so the knot is clear, and rethread the line in the hose (Fig. 4).

Early in the development of this device, the idler sheave was removed from the discharge side of the main sheave and a spring-loaded wheel with a grooved nylon face was installed to hold the line tightly in the main sheave (Fig. 5). This wheel was subsequently removed and replaced by the present steel finger, which does the job equally well and takes less space.

The idler sheave was reinstalled to facilitate setting groundlines. When setting, the groundline is paid out over the crab block with the idler sheaves holding the line in place under tension on the main sheave.

Since an erratically swinging block makes coiling difficult, the block in its present configuration is hung centered over the rail and secured in place to stop this action. Two crossed braces are attached to the block at points behind the idler sheaves and bolted to a bracket welded to the rail. The buoyline is led into the crab block from a lead block suspended outboard by a chain fastened to the rail. When traveling, the bolts at the rail are removed and the unit swings inboard.

Initially, the crab block was suspended much further outboard, and the guiding channel redirected the line through a much sharper angle. The lead roller arm was therefore modified (Fig. 3) to eliminate chafing when the line came up at an angle.

The authors are with Exploratory Fishing and Gear Research Base, National Marine Fisheries Service, NOAA, 2725 Montlake Blvd. E., Seattle, Wash. 98102.

*The use of trade names does not imply endorsement of a firm or product.

COMMERCIAL FISHERIES REVIEW
Reprint No. 904

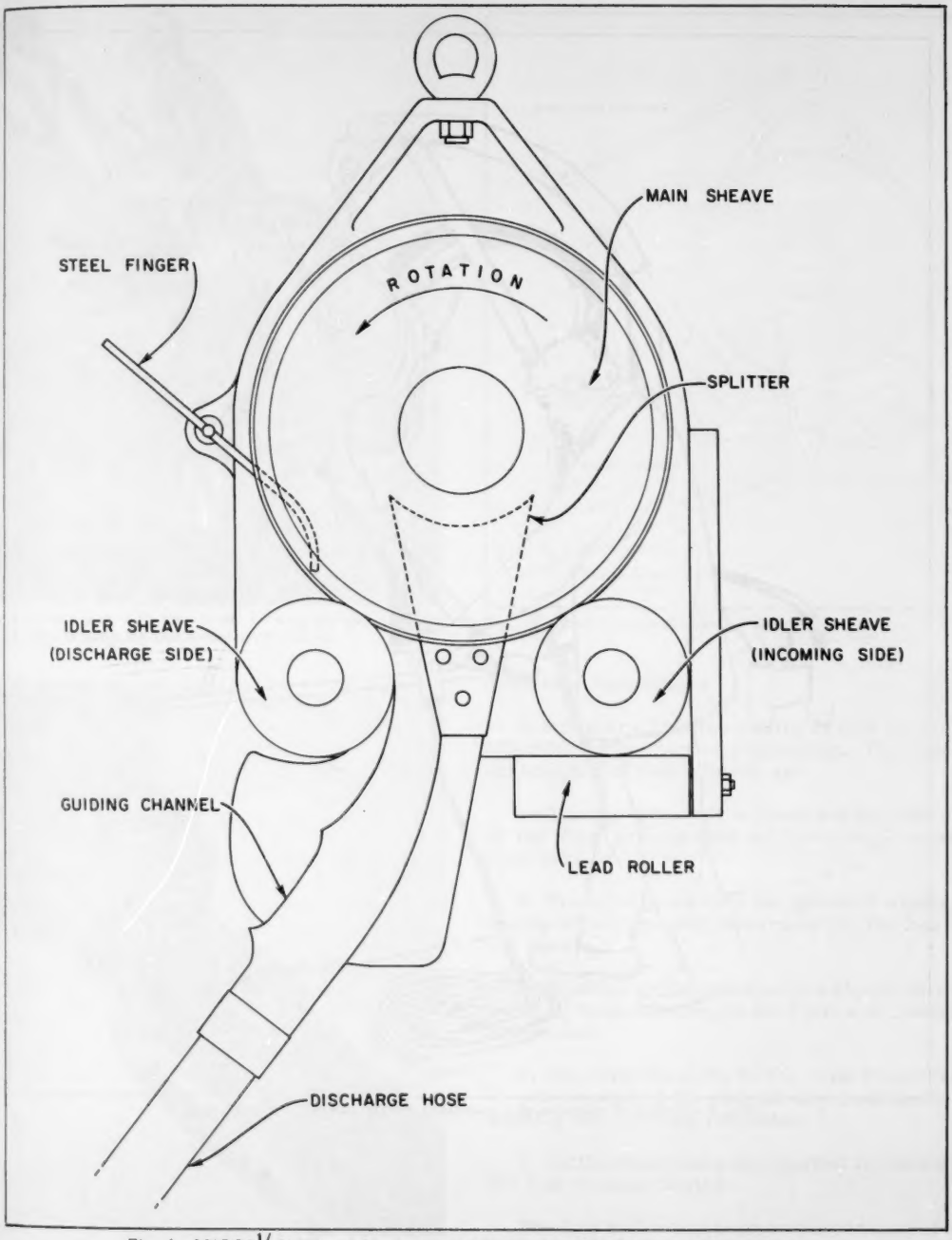


Fig. 1 - MARCO[1/] JO105 crab block with modifications to aid in high-speed line coiling.

[1/]The use of the name MARCO does not imply endorsement of a firm or product.

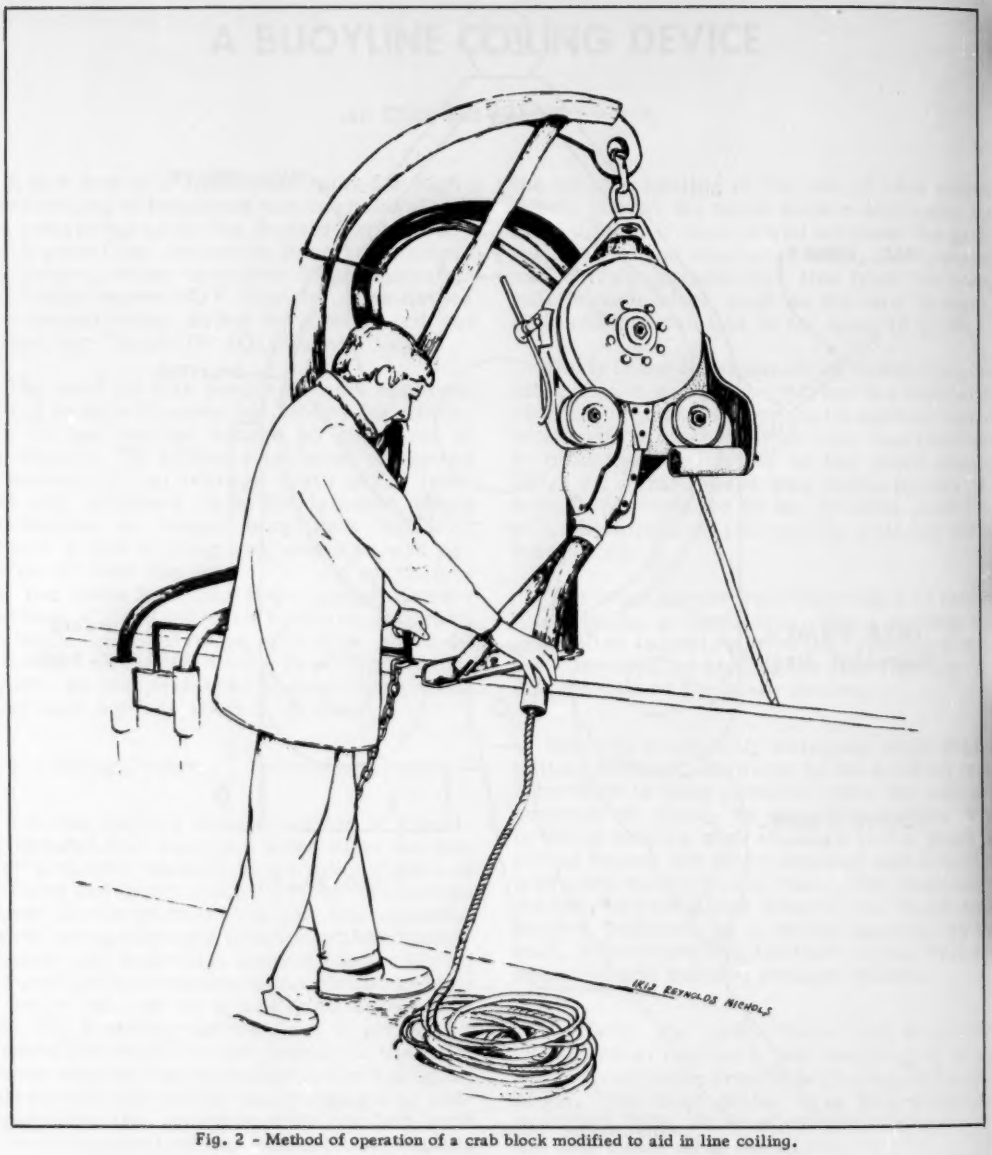


Fig. 2 - Method of operation of a crab block modified to aid in line coiling.

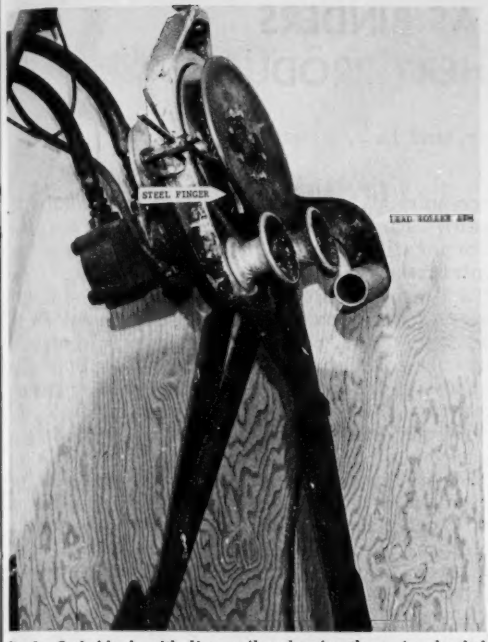


Fig. 3 - Crab block with line coiler showing the spring-loaded steel finger holding the line in the main sheave.

Fig. 4 - Discharge hose and lower end of guiding channel showing the slot for threading and removal of line. (Photos: William L. High)

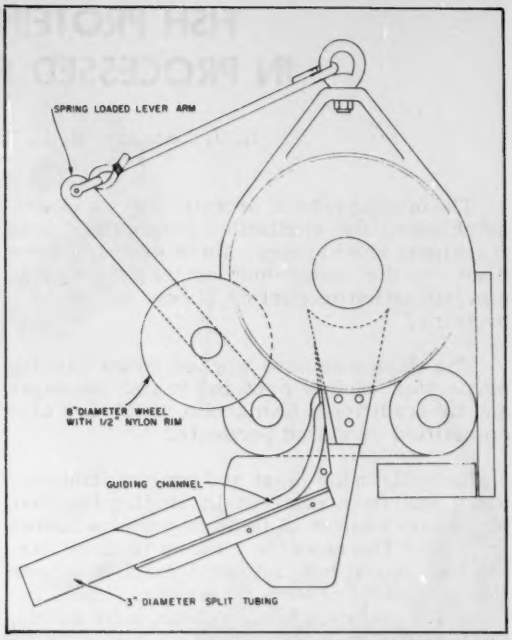


Fig. 5 - Crab block with spring-loaded wheel to hold line in the sheave.

System's Advantages

In summary, the line coiling device is very effective for deepwater pot fishing. The chief advantages of this system are:

1. The operation of the block and the coiling of the line are carried out by a single crew member.

2. The crab block may be operated continuously at full capacity, thus reducing the hauling time.

3. The line-coiling device is a simple modification to an existing, proved piece of fishing equipment.

4. The modification to the crab block can be accomplished by almost any shop having welding and burning facilities.

5. Little experience is required to operate the line-coiling device.

The line coiler has been employed successfully on the blackcod pot fishing vessel 'Seattle' for several fishing trips.

TECHNICAL NOTE

FISH PROTEINS AS BINDERS IN PROCESSED FISHERY PRODUCTS

R. J. Learson, B. L. Tinker, and L. J. Ronsivalli

The binding role of proteins has been well established for emulsified products such as frankforts and baloney. Much work has been done on the water-holding capacity and emulsification properties of beef and poultry proteins.

The Japanese have worked on the binding properties of fish proteins in fish sausages and the traditional Kamaboko, which are also emulsified or gelled products.

Recently in the meat and poultry industry, there has been interest in binding together pieces or chunks of flesh to produce loaves or rolls. The need for binders in these fabricated foods has initiated much research into a host of protein materials. These include soy protein, gluten, gelatin, milk solids, and egg whites.

At the Fishery Products Technology Laboratory in Gloucester, Mass., we became interested in the binding properties of fish proteins to increase the structural stability of fish fillets exposed to various thermal processes. Research showed that when fillets were coated with a slurry made from diluted fish muscle their physical structure was unaffected by thermal processing and storage at temperatures above freezing.

The following describes some of the research on the use of fish proteins as binders in new-product development.

THE FORMATION OF ROLLS OR LOAVES

Research was carried out to develop roll or loaf-type products incorporating other fishery products as flavoring agents. Haddock and cod fillets were comminuted (pulverized) for various times in a silent cutter (30-180 sec). Pieces of shrimp and clams were incorporated into the ground muscle and the mixtures were placed in No. 2 cans. The cans were sealed and heat-processed to internal temperatures ranging from 50 to 100° C. The resulting product, Figure 1, was a solid mass of flesh physically stable at above-freezing temperatures. For taste-testing, the rolls were sliced into 1.5 cm. portions, lightly breaded and deep-fat fried.

In general, these products were considered highly acceptable by the test panel. The flavor of the products was considered to be that of clam or shrimp and not haddock or cod. The texture of the products appeared to be related directly to the amount of grinding or the particle size of the ground fish muscle. Fish muscle comminuted for 30 seconds resulted in very little binding, whereas muscle treated for 3 minutes produced an almost rubbery texture. The heat treatment needed to bind the flesh did not appear to be critical. Highly acceptable products were prepared by heating them to internal temperatures as low as 50° C and up to 77° C. Products heated to internal temperatures above 77° C had a tendency to be dry and slightly discolored. This was especially true of heat-sterilized products.

Other products of this type were prepared using various flavoring agents such as ocean quahogs, Maine shrimp, and crab meat. All these were highly acceptable.

REFORMATION OF CRAB MEAT

As part of our blue-crab research program, we continued this line of research to develop new products from crab meat. Flake

Mr. Learson and Mr. Tinker are Research Chemists and Mr. Ronsivalli a Food Technologist with National Marine Fisheries Service, Fishery Products Technology Laboratory, Emerson Avenue, Gloucester, Mass. 01930.

COMMERCIAL FISHERIES REVIEW
Reprint No. 905

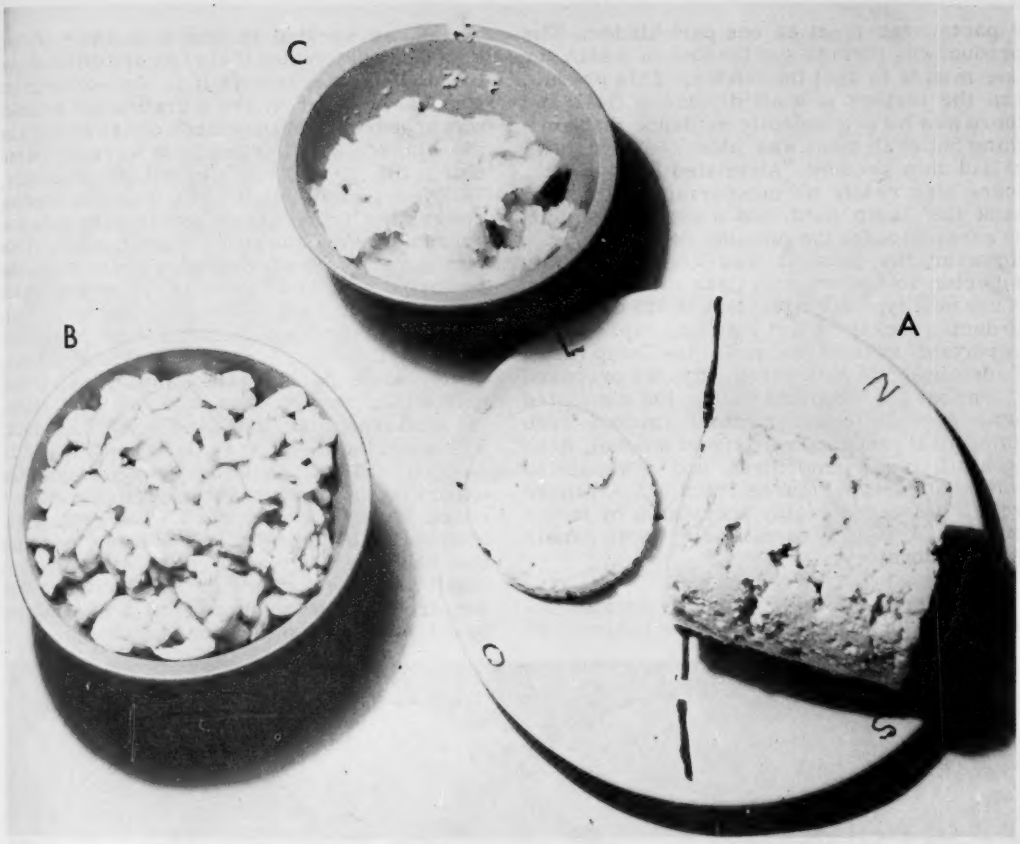


Fig. 1 - Shrimp roll (A) prepared from Maine shrimp (B) and diluted comminuted fish muscle (C).

meat, the meat picked from crab bodies, is much less desirable than the solid "back fin lump" meat. It is also more difficult to pick, resulting in an adverse effect on quality, especially with increasing labor costs. For this reason, the industry is moving towards machines to remove the meat from the bodies. To date, these machines show a tendency to break up the meat, making it less desirable for the salad or cocktail market.

Using a fish protein binder, we attempted to upgrade the broken flake meat to something similar to the desirable "back fin lump" meat now produced by the industry. A binder was prepared by grinding fish muscle in a silent cutter and mixing this with commercial-grade flake meat. The product was formed to the desired shape and sealed or bonded by steaming. A number of formulations and processing conditions were tried in an attempt to produce exactly the right texture--the texture of a solid piece of flesh. The texture of the finished product appears to be related to three interdependent variables: the size of the particles in the binder, the moisture content of the product, and the heat treatment. The binding property and product elasticity increased with decreasing particle size and decreasing moisture content. The application of heat decreased the moisture content and increased the binding property. The most acceptable product was prepared in the following manner:

Haddock or cod fillets were comminuted in a silent cutter for 60 seconds. The binder was prepared by mixing 8 parts fish flesh to 2 parts water. Commercial blue-crab flake meat was mixed with the binder at a ratio of

9 parts crab meat to one part binder. The product was formed and treated in steam for one minute to seal the binder. This product had the texture of a solid piece of flesh and there was no organoleptic evidence that anything but crab meat was added. Although we called this product "simulated lump meat", there was really no comparison with "real back fin" lump meat, and it certainly cannot be substituted for the genuine "back fin" lump. However, the product was considered far superior to the original flake meat in terms of versatility, and the fact that it did not break up during packaging and handling represented important advantages over the lump meat. To demonstrate this versatility, we prepared a number of products using the simulated lump meat. These included smoked crab (lump meat prepared with liquid smoke), crab cocktail, fried lump meat, and a simulated soft-shell crab (Figures 2 and 3). All these were considered highly acceptable by members of the industry as well as by taste panels at the laboratory.

Since most of this work was carried out on cod and haddock muscle as the binder material, we decided to test a number of fish species to determine if there were differences in binding characteristics. An experiment was carried out where a crab-meat product was prepared using a number of fish species as the binder. All the products were prepared using the previously described procedure. To give an indication of the relative binding power, the force necessary to penetrate the product was measured for each binder. This was done by measuring on a gram scale the pressure required to pierce the product with a steel shaft (flat end--diameter = 0.5 cm). The binders tested included flesh from cod, haddock, flounder, ocean perch, whiting, hake, skate, white perch, skup, mullet, sea trout, butterfish, striped bass, and raw crab flesh. We also tested haddock binder (80% haddock, 20% water) stored for 10 days at 1° C and 11 days at -20° C. Within the accuracy of the experiment, we found no significant differences among fish samples. The crab flesh, however, had binding properties far less than the fish flesh. To achieve the same product elasticity, a heat treatment of 25 minutes was required. This compares to a one-minute heat treatment for the others.

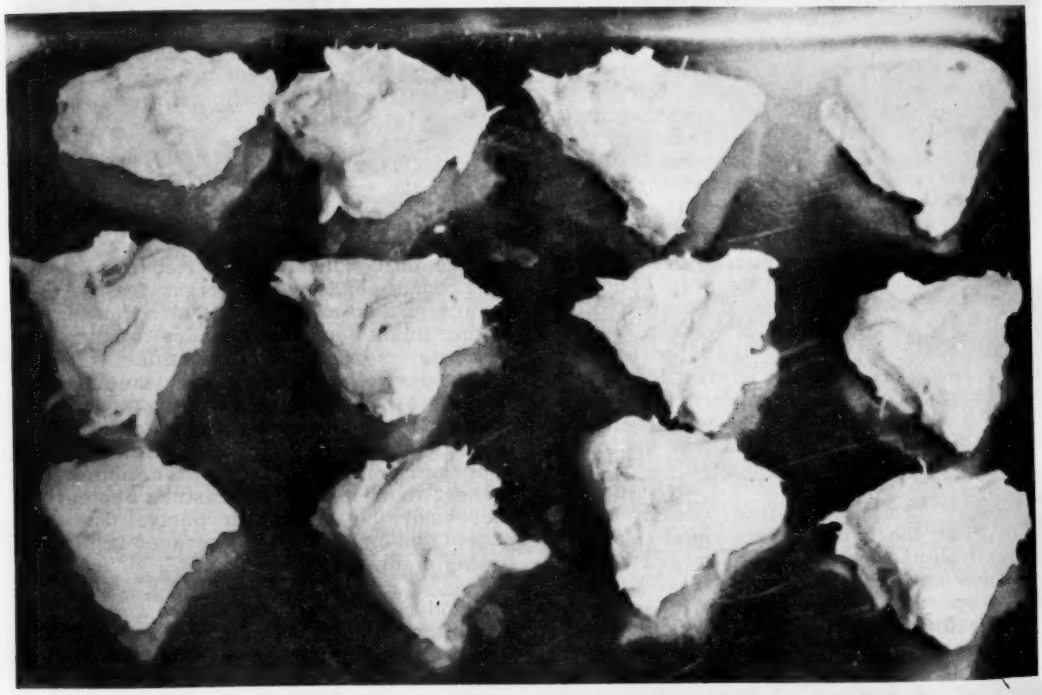


Fig. 2 - Simulated blue crab lump meat prepared with 90% flake meat and 10% fish protein binder.

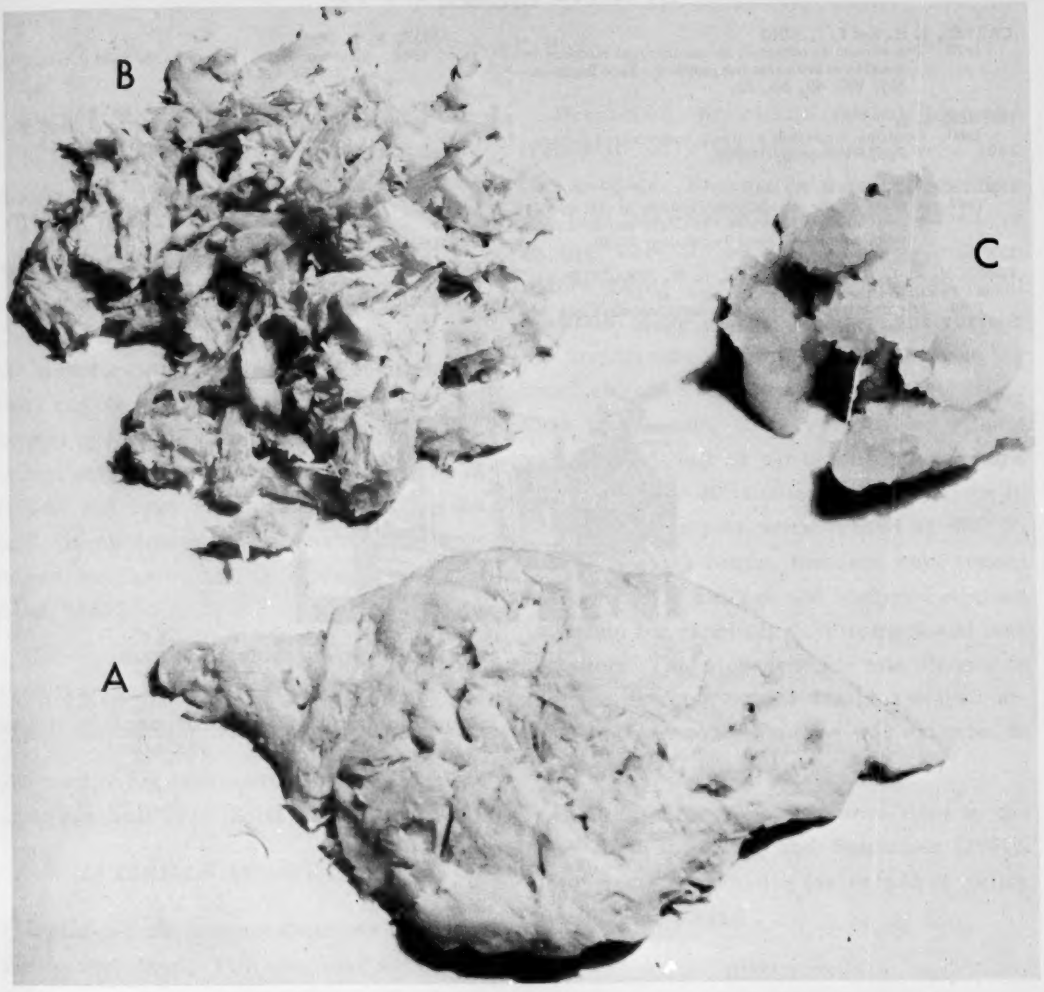


Fig. 3 - Simulated soft shell crab (A) prepared with 90% flake meat (B) and 10% fish protein binder (C).

SUMMARY

In general, all our data indicate that the role of fish proteins is similar to that theorized for meat. The application of heat produces an unravelling of the protein and random cross linking by means of hydrogen bonding. The cross linking of randomly organized protein mixed with connective tissue is responsible for the tightly adhering mass.

So, in general, it appears that a fish-protein binder can be used effectively in the development of formed fishery products. The binder material is cheap and easy to obtain by means of meat/bone separators. It is reasonably stable at both refrigerated and frozen temperatures. It can be flavored and colored and, finally, it is a protein natural to fishery products and readily available to fish processors.

REFERENCES

CARVER, J. H. and F. J. KING
1970. The economic potential for mechanical recovery of meat from low value fish products. Food Engineering, Vol. 42, No. 10.

HANSEN, L. J.
1960. Emulsion formation in finely comminuted sausage. Food Technology 14:565.

HUDSPETH, J. P. and K. N. MAY
1967. A study of the emulsifying capacity of salt soluble proteins of poultry meat. 1. Light and dark meat tissue of ducks. Food Technology 21:89.

LEARSON, R. J., L. J. RONSIVALLI, B. W. SPRACKLIN, and F. HEILIGMAN
1969. Process criteria for producing radiation-sterilized fish products. Food Technology 23:85.

SAFFLE, R. L.
1968. Meat emulsion. Advances in Food Research, Vol. 16:105, Academic Press.

SWIFT, C. E., C. LOCKETT, and A. J. FRYAR
1961. Comminuted meat emulsions. The capacity of meat for emulsion. Food Technology, 15:468.

TANIKAWA, E.
1963. Fish sausage and ham industry in Japan. Advances in Food Research, Vol. 12:368, Academic Press.

VADEHRA, D. V. and R. C. BAKER
1970. The mechanism of heat-initiated binding of poultry meat. Food Technology, 24:766.

GLUCOSE OXIDASE REDUCES OXIDATION IN FROZEN SHRIMP

Carolyn Kelley

Glucose oxidase-catalase, an oxygen-utilizing enzyme system, has been used successfully to decrease oxidation and loss of color in frozen Alaska pink shrimp.

Oxygen plays an important role in many of the problems of modern food processing. The oxidative rancidity in fat-containing foods and discolorations or loss of color in many foods can be attributed, at least in part, to oxygen. Freezing rather than canning, convenient small-size portions, and the use of cartons and bags rather than cans or glass have all accentuated the destructive role oxygen can have during storage of foods (Scott, 1958).

Glucose oxidase-catalase preparations are used to carry out the net reaction: 2 glucose + oxygen $\xrightarrow[\text{catalase}]{\text{glucose oxidase}}$ 2 gluconic acid. The reaction proceeds until either the glucose or oxygen is all used (Scott and Craig, 1967).

MATERIALS AND METHODS

A commercial enzyme Ovazyme (1) preparation was used. Two solutions were prepared containing equivalent amounts of this enzyme, one to be used in place of the usual brine dip, and the other to be added in small amounts directly to the cans.

Precooked, machine peeled, blanched (ready-to-eat) Alaska pink shrimp were used for samples. Enzyme solutions either were put into the cans and the shrimp added, or shrimp were dipped into an enzyme solution before being put into the cans. Several amounts of the enzyme solution and various dip treatments were used to determine the most effective amount of glucose oxidase to have in the can. Cans were sealed without vacuum and left at ambient temperature (45-50° F) for 30 minutes for the enzyme to act before samples were frozen at -20° F. After about 24 hours, the cans were transferred to 0° F storage and analyzed at given intervals for rancidity development and loss of color. The storage study was planned to last six months, but the samples stayed unexpectedly fresh so the time was extended to a year.

Analyses for rancidity were done by the TBA method of Yu and Sinnhuber (1967). Color was determined by the method of Kelley and Harmon (1971).

RESULTS

Analyses for rancidity showed that glucose oxidase in any amount tried was effective in reducing rancidity when shrimp was dipped

The author is a chemist with National Marine Fisheries Service Technological Laboratory, Ketchikan, Alaska 99901.

(1) The use of trade names is merely to facilitate description; no endorsement is implied. Fermco Labs, Chicago, Ill., donated the Ovazyme.

COMMERCIAL FISHERIES REVIEW
Reprint No. 906

in it, or when it was added to the can. After the year of storage, the untreated control sample has a rancidity value of 1.32, and treated samples values ranged from 0.71 to 0.98. The loss of color in the untreated control was 29.1%, and treated samples ranged from 9.0-20.0% loss of color.

SOME THOUGHTS ABOUT THE WORK

Loss of color is usually not as large when shrimp are not exposed to light. The benefits of glucose oxidase-catalase would probably be more obvious in shrimp, which were packed in transparent bags rather than cans.

In this work, rancidity was less with larger amounts of glucose oxidase-catalase present. The removal of oxygen in the closed container is a function of both amount of enzyme present and time in which enzyme was active. The effectiveness of the glucose oxidase-catalase could probably be increased if optimum amounts, delay time, and temperature requirements were identified for given container sizes. If, for economic reasons, it were desirable to reduce the amount of glucose oxidase-catalase, a longer time between sealing and freezing would probably compensate for the smaller amount of enzyme.

It remains unknown whether freezing completely inactivates the enzyme system. Some unreported work in connection with this study indicated that the enzyme may become active again if the closed container is brought back to ambient temperature for a while. If this proves true, glucose oxidase-catalase may be especially useful for removing trace oxygen during shipment when temperatures may fluctuate considerably and oxidation could occur.

LITERATURE CITED

KELLEY, C. and A. HARMON
1971. Determination of carotenoids in pink shrimp. Submitted to J. of Agricultural and Food Chemistry.

SCOTT, D.
1958. Enzymatic oxygen removal from packaged foods. Food Tech. 12:7, 8, 11, 13-17.

SCOTT, D and T. CRAIG
1967. Maintaining freshness (flavor and color) of bottled citrus beverages. Beverages, 8:2 (April-May 1967).

YU, T. C. and R. SINNHUBER
1967. An improved 2-thiobarbituric acid (TBA) procedure for the measurement of autoxidation in fresh oils. J. Am. Oil Chem. Soc. 44:256-258.

WORLD FISH MEAL PRODUCTION RISES

During Jan.-Sept. 1970, fish-meal output by major producers-exporters, Peru, Norway, and Chile, totaled nearly 2.6 million short tons; the figure was 1.8 million in 1969 period. The 3 nations export about 97% of their output and account for about 75% of world exports. This was reported in "Foreign Agriculture," U.S. Dept. of Agriculture, Jan. 11, 1971.

Their combined exports during Jan.-Sept. 1970 were 2.1 million tons--only 47,000 tons above 1969 period--and 487,000 tons less than production. In 1969, exports at just over 2 million tons had exceeded production by over 200,000 tons. A substantial buildup in stocks occurred in 1970. The last time it happened was in 1967. That was followed in 1968 by heavy stock dispersals, which boosted exports to 5% over production.

Imports by 'Big 8' Drop

The 1969 decline in imports into 8 selected countries continued through the first 9 months of 1970. In the past, the '8' had taken bulk of imports. The decline resulted from relatively scarce supplies and high prices that began in May 1969.

Imports by the '8'--at 1.4 million tons for Jan.-Sept.--were down 365,000 tons (20%) from level of 1969 period. When compared with exports, 600,000 tons remain unaccounted. This may reflect, in part, the lag between export and import data; and, partly, possibility that larger quantity is probably moving to other importing countries in East and West Europe.

Agriculture Dept. Observations

Although 1971 fish-meal production "is indeterminate," says U.S. Department of Agriculture, several observations can be made:

(1) Aggregate fish-meal production in the three major countries trended upward at annual average volume of 246,700 short tons during 1960-68 period.

(2) Their production since 1960 increased in 7 years and declined only in 2--1965 and 1969.

(3) Exports from the three have accounted for over 95% of combined output. During 1960-68, it trended upward at volume of 243,900 tons annually.

(4) Export availabilities in 1971 from 1971 production would amount to 2.7 million tons--if 1971 production does no more than stagnate at 1970 volume, currently estimated at 2.85 million tons, and local use continues at about 150,000 tons.

(5) Also, a substantial quantity of fish meal (roughly 380,000 tons) accumulated in 1970 will be available for export.

(6) Although aggregate imports into major consuming countries declined sharply in 1969, and continued to decline in 1970, imports into all countries, except U.S., were well maintained through 1969. Only in 1970 was decline in fish-meal availabilities felt in major consuming countries. This indicates that U.S. exports of soybeans and meal were not affected by 1969 decline in fish meal availabilities--but did benefit significantly from reduction in 1970.

(7) In 1970, fish-meal production may have reached record. However, as before, impact of large production would not be felt in consuming countries until 1971.

JAPANESE ARE PESSIMISTIC ABOUT 1971 FISHERY EXPORTS

The Japanese fishing industry is apprehensive over recent U.S. actions banning the sale of mercury-contaminated fishery products. In 1970, Japan sold to the U.S. 3.3 million cases of canned tuna worth about US$36 million. This was almost 10% of all fishery exports. Exporters expect U.S. purchases to drop to practically nothing while the mercury problem is studied in the U.S. The same is true for frozen tuna and swordfish.

The U.S. also has banned imports of whale meat and oil under the Endangered Species Act. ('Japanese Economic Journal', Jan. 19, 1971.)

Although exports of whale products to the U.S. were worth only $2.5 million in 1970, the ban will hit whalers hard for 2 reasons: there is a high profit ratio in the sale of whale products, and the industry already is troubled.

Canned Tuna No. 1

Canned tuna is Japan's most important fishery export. In 1969, sales expanded 20% to $66 million. More than half was bought by the U.S., the rest by West Europe. Japanese sources report several European Community nations, particularly Italy and France, are considering minimum import prices for Japanese canned tuna to protect domestic producers.

Japanese frozen tuna exports to the U.S. were worth $35 million in 1969.

On Jan. 20, 1971, the U.S. National Fisheries Institute announced that under provisions of existing contracts 5 million lbs. of frozen swordfish, worth $2 million, would be returned to Japan because of high mercury levels. The swordfish can be sold in Japan if the government permits. ('Japan Times', Jan. 22, 1971.)

W. German Situation

West Germany, too, is seriously concerned about mercury-in-tuna situation. A movement is under way to prohibit sales of canned tuna containing more than 0.4 part mercury in a million parts of canned tuna. Some buyers are demanding that Japanese exporters of canned tuna attach certificates attesting less than 0.4 ppm mercury.

The move by West Germany to establish a more rigid standard than the U.S. apparently is aimed at preventing the diversion of U.S.-rejected shipments to W. Germany.

Japanese exporters claim they cannot comply with German demand because Japan's position is not to issue individual certificates for canned tuna exports. The West German move will hurt because W. Germany is Japan's second-best canned-tuna market (after U.S.) and best market for Japanese canned tuna in oil. ('Suisan Tsushin', Jan. 14, 1971.)

NMFS Comment: Japan used to be net exporter of fishery products. During last few years, it has imported more and more. In 1969, fishery imports increased 30% over 1968 to $261 million; exports decreased 2% to $347 million. The continued rapid decrease of exports could severely affect fishery trade balance.

JAPAN

FISHERY BUDGET IS RAISED FOR FISCAL YEAR 1971

The Japanese Government approved on Dec. 30, 1970, the Fisheries Agency budget of 50,052 million yen (US$139 million) for fiscal year (FY) 1971 (April 1971-March 1972). The requested sum is 23.7% higher than the FY 1970 fishery budget of 40,462 million yen ($112.4 million).

Some Large Increases

The Agency is requesting large increases for: improvement of fishing ports (26.3%); development of deep-sea fisheries (53.4%), which includes establishment of a $278,000 marine fishery center; and a marketing program including a $47,000-subsidy for experimental tuna marketing.

For first time, the Fisheries Agency is seeking funds to control pollution on fishing grounds ($267,000).

Amounts for some programs are shown below. ('Nihon Suisan Shimbun', Jan. 6, 1971.)

Program	Proposed FY 1971 Budget	FY 1970 Budget
	(US$1,000)	
Fishing ports improvement	75,917	60,105
Fishing industry disaster compensation system	4,530	6,411
Fishermen disaster compensation system	4,423	4,409
Deep-sea fisheries development	3,490	2,275
Fishery products marketing program	2,083	1,062
International fisheries biological research	816	700
North Pacific fisheries enforcement	778	592
Distant-water fisheries enforcement	552	511
Fish culture center	479	435
Fishing ground pollution control	267	-
Marine resources conservation	235	201
Fish culture experimental projects	145	187
Coastal/offshore fisheries forecasting	84	83
Other	45,201	35,429
Total	139,000	112,400

* * *

SAURY PRICES RISE AS LANDINGS FALL

Saury prices in Japan have risen sharply in recent years as landings declined. Once considered poor man's food, the saury now is high priced.

In 1969, landings declined 60% from 1968 and reached a record low of 52,200 metric tons; the average exvessel price tripled. So earnings of vessel owners suffered less than had been expected.

Earlier Season Opening Suggested

Still, saury fishermen want to increase the catch to make the fish available to all. Fishing captains have suggested an earlier season opening. ('Shin Suisan Shimbun', Feb. 1, 1971.)

* * *

SQUID FISHING OFF U.S. EAST COAST IMPROVES

Japanese trawlers fishing squid off New York since late Nov. 1970 reported in Jan. 1971 that fishing had improved. Earlier reports had indicated that about 14 trawlers were having difficulty finding good concentrations. Although January catches were still

JAPAN (Contd.):

below 1970 peak-season catch, some vessels were hauling in close to 10 metric tons a day.

European Price Drop

The Japanese firms hope to export squid to Europe at US$400/metric ton (cost, insurance, freight). However, the European price will almost definitely decline to $300/ton level, about half the 1969 price. The Japanese fear they may not be able to make any profit.

Butterfish & Argentine

Prior to squid, the trawlers concentrated on butterfish and argentine. In early Jan. 1971, 1,800 tons of East Coast catch (1,400 tons butterfish, 400 tons ocean perch and argentines) arrived in Japan. There the butterfish packed in 44-lb. boxes brought 5,800 yen ($16.11) a box wholesale. ('Minato Shimbun', Jan. 14, 1971.)

. . .

NMFS Comment: The Japanese wholesale price for butterfish was $0.37 a pound. Recent U.S. prices were:

wholesale Baltimore US$0.35
wholesale New York US$0.35-40
retail Baltimore (Dec. 1970) US$0.69-0.79.

* * *

REPORT ON SHRIMP INDUSTRY TRENDS

About 70 Japanese shrimp trawlers were fishing in the Caribbean Sea off the Guianas (South America) in Jan. 1971. The trawlers began organized fishing 4 years ago. They lost money because their crews were not familiar with the grounds.

Over the years, however, crew skill improved steadily, mechanical refrigeration was installed. Now most trawlers are operating profitably.

1970 Catch

In 1970, their combined shrimp catch off the Guianas was 5,768,190 pounds--about 5% above 1969 catch of about 5.5 million pounds.

The catch, mostly pink and brown shrimp, is exported to the U.S. and Japan. ('Suisan Keizai Shimbun', Jan. 27, 1971.)

Prices Firm in Japan

Frozen shrimp wholesale prices in Japan generally are holding firm. Prices for large sizes, in short supply, continue high due to strong institutional demand. But the plentiful smaller sizes, particularly 31-40 counts, are steady. ('Suisan Tsushin', Feb. 3, 1971.)

* * *

IMPORTS OF FROZEN SHRIMP FROM AFRICA ARE INCREASING

In 1970, Japanese imports of frozen shrimp from Africa, especially from Nigeria and Senegal, increased. During 1969, Japan imported 530 metric tons from Nigeria, 286 tons from Senegal, 104 tons from Tanzania, and 47 tons from Mozambique.

Liberia, Ivory Coast, Gabon, and Cameroun also supplied shrimp in 1970. Although the quantities were small, Japan expects shipments to increase because of Japanese exploratory fishing off Gabon and Cameroun.

Senegal Largest Supplier

In 1970, Senegal was the largest west African supplier of shrimp to Japan: 238 tons in Jan.-July. In 1967, Tomen, a Japanese trading firm, began to import frozen shrimp from Senegal; by Sept. 1970, it had reached 50 tons. Tomen believes that only significant catch improvement will make it profitable for Japanese to fish off Senegal.

Shrimp from Senegal are mainly white with a predominant count of 26 to 30 and 41 to 50, heads on, per pound. The Japanese market for these is good. Shrimp with a count of 50 or over, heads on, are exported to Europe. ('Suisan Keizai')

. . .

NMFS Comment: Imports of shrimp from Africa are small part of Japanese shrimp imports: 3.1% in 1969. Total 1969 Japanese imports of shrimp were 48,885.7 metric tons worth US$121,747,500. In 1970, these fell to 45,187.4 MT worth US$106,835,833 (Africa 3.4%).

But imports from Africa are increasing rapidly. In 1969, six African countries exported 1,734 metric tons worth US$3.7 million. According to Japan, Madagascar led

JAPAN (Contd.):

with 760 tons, followed by Nigeria, 530 tons; Senegal, 286; Tanzania, 104; and Mozambique, 47. Somalia exported negligible amount.

During first 9 months of 1970, significant changes occurred. Five countries joined the 6 that exported in 1969: Ivory Coast, 137 tons; Liberia, 36 tons; Gabon, 27; Cameroun, 8; Angola, 1. Madagascar remains chief supplier, 790 tons, but imports from Nigeria have decreased significantly, to 212 tons. This contradicts information supplied by 'Suisan Tsushin'. Imports from Senegal fell to 272 tons in first 3 quarters of 1970.

It appears that the Japanese, to maintain African shrimp supplies for ever-increasing domestic demand, are rapidly establishing joint ventures in most coastal African countries.

* * *

HIROSHIMA OYSTER GROWERS WORRY ABOUT S. KOREAN IMPORTS

In Jan. 1971, when oyster harvest was at its peak, the Hiroshima oyster growers worried about imports from Republic of Korea (ROK) by a Japanese firm.

For about a year, the San-ei Suisan, Hiroshima's largest wholesaler of oysters, had been culturing oysters in Korea, with ROK support, in waters much cleaner than Hiroshima's.

S. Korean Oysters

In 1970, the wholesaler had imported from ROK 30 metric tons in the shell and shucked them (yield 4 tons of meats). A small part was sent to Tokyo Fish Market. It sold fresh at 11,000 yen per 20 kilograms (US$1.53/kilo), below market price of Hiroshima oysters. The Korean oysters harvested more than a week earlier (twice time allowed Hiroshima oysters destined for fresh consumption) were not best quality. They were used mostly for canning.

Origin of Oysters Troublesome

The 4 tons are negligible compared with Hiroshima's annual shucking of 32,000 tons. However, even if Korean oysters are frozen or canned, they are likely to be regarded as Hiroshima oysters because importer is Hiroshima's largest. (It handles nearly 20% of city's oyster sales.) Some oyster growers in Hiroshima tried to eliminate San-ei Suisan, but they failed because of company's long association with oyster growers. ('Minato Shimbun', Jan. 7, 1971.)

* * *

NICHIRO IS PURSE SEINING OFF WEST AFRICA

The Nichiro Company's purse-seine fleet caught 4,500 to 4,700 metric tons of tuna during July-Dec. 1970 in the eastern Atlantic off West Africa. This almost equals fleet's catch target of 4,800 tons. Although more skipjack and fewer yellowfin were taken than anticipated, the trip is expected to show a profit.

1970 Fleet Reorganization

Previously, Nichiro had lost money each year in purse seining off West Africa. In 1970, the fleet was reorganized and reduced from 6 pair-boat seiners and 2 motherships to 3 pair-boat seiners (9 vessels, including 3 skiffs) supported by 3,600-gross-ton mothership 'Hiroshima Maru'.

1971 Fleet Plans

The fleet fished until end of Jan. 1971. The mothership returned to Japan and will head back for West Africa in May. During that period, the seiners will be docked in an east Atlantic port. ('Minato Shimbun', Jan. 15, 1971.)

* * *

RECORD MOTHERSHIP-TYPE BOTTOMFISH CATCH IN BERING SEA IN 1970

The 1970 Bering Sea bottomfish catch by 10 Japanese mothership fleets reached record 1,184,000 metric tons. This surpassed by 38% previous high of 855,000 metric tons in 1969.

The large gain was attributed to increase in Alaska pollock landings--over 87% of catch. These landings have been increasing yearly since fleets began producing "surimi" (minced fish meat). ('Minato Shimbun', Jan. 22, 1971.)

JAPAN (Contd.):

Bottomfish Catch in Bering Sea

	1970	1969
	(Metric Tons)	
Alaska pollock	1,031,000	678,000
Flatfishes	89,000	106,000 1/
Cod	47,000	39,000
Herring	9,000	11,000
Sablefish	3,000	4,000
Pacific Ocean perch	2,000	11,000
Shrimp	2,000	4,000
Other species	1,000	2,000
Total	1,184,000	855,000 2/

1/Includes 96,800 tons of flounders and 9,5000 tons of arrow-toothed halibut.
2/The 1969 figures are rounded off. Catch was 854,600 tons.

* * *

TOKAI UNIVERSITY CULTURES TUNA SPECIES AND DOLPHIN

A 3-year study of the culture of tuna, skipjack, and dolphin is being conducted by Tokai University's College of Marine Science and Technology. The study is part of a Fisheries Agency program of marine culture of commercially important fish species begun in 1970.

The college has been rearing about 200 tuna, skipjack, and dolphin since Aug. 12 and reports that commercial culture of tuna and skipjack is promising.

Tuna, Skipjack, Dolphin

Tuna and skipjack, which normally swim straight, are extremely difficult to rear in a small tank. The rearing of one bluefin tuna for 2 months by Nagasaki Prefectural Fisheries Experimental Station is the longest.

On Aug. 12, 1970, at Mera Bay, the researchers began rearing bluefin tuna, skipjack, and dolphin in a seawater pen 10 meters long, 10 meters wide, and 1.5 meters deep--and in a tank 3.5 meters long, 3.5 meters wide, and 1.5 meters deep. Experiments also were carried out in a training pool 5 meters in diameter and 2.5 meters deep.

Several fish have died, but 200 (including dolphin) now can be seen swimming in groups. The experiment has passed its most difficult stage, the fish are feeding well, and survival should be good.

What's Ahead

Prof. Motoo Inoue, in charge of experiment, foresees no serious problems during winter.

The next objective will be to rear them to maturity and to spawn them artificially. Inoue also wants to fertilize skipjack eggs artificially aboard a vessel in waters around Bonin and Mariana Islands, and yellowfin and bigeyed around Truk Island. He plans to catch young tuna with lights and to rear them. He will collect tuna eggs with a net and hatch them in laboratory. ('Suisan Keizai')

* * *

UNDERWATER HABITAT NEARS COMPLETION

A nearly $1-million submarine habitat begun in a Kanagawa Prefecture shipyard in 1969 was scheduled to be completed in February 1971.

The Japanese Science and Technology Agency (STAA) is building the habitat, known as "Undersea Operation Base". It will be installed on seabed 30 meters deep off Ito, Shizuoka Prefecture. The habitat consists of a main 65-ton compartment with workshops and living-quarters, an elevator, and surface buoys. The compartment is cylindrical and measures 10.9 meters long and 6.5 meters high. It is designed to withstand pressures at a depth of 110 meters. Inside are a bedroom for four, a kitchen-dinette with hot running water, laboratories, and the central control office. STAA said it was designed to accommodate four persons comfortably for one month.

Experiment in Nov. 1971

Four aquanauts will occupy it in Nov. 1971. They will breathe artificial air--95% helium and 5% oxygen. Because helium extracts heat from human body, room temperature will have to be kept at 28° C. to 32° C. (82.4°-89.6° F.) with electric heater.

Another disadvantage is dietary. The aquanauts may only eat frozen food thawed in hot water. Flame is forbidden in the artificial air. Four-man teams will take turns living in the

JAPAN (Contd.):

craft for 5 days. They will photograph marine life, sample soil from seabed, and examine effects of high underwater pressures.

If first experiment is successful, the craft will be lowered to 60 meters for another experiment in 1972, and to 100 meters in 1973.

24 Being Trained

Twenty-four youths, including graduate students and employes of ocean-oriented companies, are undergoing intensive training.

STAA officials say Japan is 5 to 8 years behind France and the U.S. in this field. There, successful experiments with similar craft have been conducted in depths ranging from 130 to 186 meters. ('Japan Times', Jan. 1, 1971.)

* * *

PHASES OUT FISHING IN NEW ZEALAND WATERS

The 3-year Japan-New Zealand fishery agreement, concluded in October 1967, expired on Dec. 31, 1970. It had allowed the Japanese to fish within New Zealand's 12-mile fishery limit up to 6 miles from the coast. Japan was limited to 17 vessels, total tonnage 6,000 GRT, and had to furnish a list of vessels fishing in the area each month.

New Zealanders Want Fish

The Japanese are hoping to extend the agreement, but their extensive mothership operations and large catches, mostly sea bream, have been eye-openers to New Zealanders, who will try to catch the fish themselves. But their coastal vessels are small and not equipped for large, efficient fishing.

New Zealanders reported that Japanese violated agreement many times by coming closer than 6 miles and will now violate New Zealand's 12-mile fishery limits. (From 'Asahi Evening News', Jan. 1, 1971.)

. . .

NMFS Comment: Japanese officials have been soft on companies that violated the agreement; penalties have been mostly administrative not financial. Japanese had hoped to form several joint ventures to exploit fishery resources within 12-mile limit. However, findings of 1969 survey team discourage this scheme. Nevertheless, Taiyo established joint venture with A.G. Wicelams Co. in Sept. 1967--capitalization US$368,000, 27.4% contributed by Taiyo ($100,800).

* * *

LARGE PURSE SEINER LAUNCHED

The 99-GRT purse seiner 'Nippon Maru', first Japanese-built seiner of its size, is scheduled for delivery to its owners, the Overseas Purse Seine Fishing Co., in early April 1971.

Its Vital Statistics

The vessel is modeled after U.S. tuna seiners. It will be equipped with U.S. power block and use four U.S. 65-hp., 45-knot speed boats. Main specifications are: overall length 59.05 meters (193.7 feet), width 11.8 meters (38.7 feet), depth 7.68 meters (25.2 feet), main engine 3,500 hp., speed 16 knots, crew 17. Total construction costs, including speed boats, will reach 620 million yen (US$1.72 million).

Hopes on New Seiner

The Japanese are pinning much hope on the Nippon Maru in their contest with U.S. seiners. It will be sent to eastern Pacific yellowfin and skipjack grounds around May 1971. Two-thirds of the operating costs will be subsidized by the government, which has designated it to explore for new fishing grounds. ('Minato Shimbun', Jan. 31, 1971.)

The seiner will have a brine-freezing unit (minimum temperature -0.4° F.). It will fish for 4 years without returning to Japan; crew replacements will be flown out periodically.

. . .

NMFS Comment: The Overseas Purse Seine Fishing Co., established in June 1970, sent representatives in Sept. 1970 to San Diego, Calif., to hire a U.S. trawl master for its new purse seiner. In Oct. 1970, 7 U.S. tuna fishermen were hired to give technical advice and to help crew the vessel. The ship's master and the chief engineer, however, will be Japanese.

Since the vessel will not be ready until April 1971, after closure of regulatory yellowfin season, skipjack tuna will be fished instead.

□□□□□□□□

TAIWAN

1970 FISH PRODUCTION INCREASED 9.3% OVER 1969

Taiwan's fish production in 1970 totalled 613,044 m.t., an increase of 9.3% over the 560,783 m.t. of 1969. The 1970 production of each fishery category compared with 1969 was:

	1970 (m.t.)	1969 (m.t.)	Increase m.t.	Increase %
Total	613,044	560,783	52,261	9.3
Deep-sea	277,955	255,057	22,898	9.0
Inshore	234,704	221,646	13,058	5.9
Coastal	27,690	27,010	674	2.5
Fish culture	72,695	57,064	15,631	27.4

The production target set for 1971 is 665,000 m.t. with the following breakdown: Deep-sea fisheries, 329,000 m.t.; inshore fisheries, 241,000 m.t.; coastal fisheries, 25,000 m.t.; and fish culture, 70,000 m.t.

Fish Export

The export of fishery products in 1970 totalled US$66.7 million compared with US$44.7 million in 1969. Most of the fish exported are frozen tuna and marlin transshipped from overseas ports. Shrimp is the next important export item.

Artificial Propagation of Mullet

Continuing the experiment of the 1969-1970 season, the Tungkang Marine Laboratory succeeded in rearing the hatchlings of the grey mullet to stocking size. From a fish stripped on Dec. 21, 1970, 6,000 fingerlings survived and grew to 2.2 cm in length as of Jan. 31, 1971. It is expected that the Laboratory will be able to produce 20,000 to 25,000 mullet fingerlings this winter to a size suitable for stocking.

The Laboratory also succeeded in breeding for the first time a pond-reared mullet of about 3½ years in age on January 17th. Several thousand hatchlings have survived and were in healthy condition at the time of this report, Feb. 5, 1970.

T. P. Chen
Chief, Fisheries Division
Joint Commission on Rural Reconstruction, Taiwan

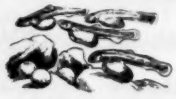
* * *

PLANS TO BUILD TUNA LONGLINERS

The Taiwanese have scheduled construction of forty 250-GRT tuna longliners. Government approved, the vessels will be financed by a US$10 million loan from Asian Development Bank (70%), and private Taiwanese capital (30%).

Tuna-Mercury Problem

The tuna-mercury problem encountered in the U.S. in Dec. 1970 had generated arguments against building tuna vessels, but the Taiwan Fisheries Bureau decided to go ahead. The Bureau reportedly said its future efforts will be directed toward building large purse seiners. ('Katsuo-maguro Tsushin', Jan. 26, 1971.)



EUROPE

USSR

BUYS FISH-MEAL PLANTS FROM DENMARK

After years of negotiations in Moscow and Copenhagen, the Danish firm Atlas has secured a Soviet order for 20 million DKr. (US$2.66 million) to deliver 8 fish-meal plants for 2 factoryships. The combined daily production capacity of each vessel, 1,200 metric tons of raw fish, will yield about 400 tons of meal.

New-Type Vessels

The vessels are 2 new types built at a Soviet shipyard. They will be equipped too with freezing and filleting equipment.

Atlas previously had delivered smaller fish-meal plants for Soviet vessels. Several were built at Burmeister & Wain Shipyard in Copenhagen. (U.S. Embassy, Copenhagen.)

* * *

'FROST-PROOF' RESERVOIRS FOR LIVE CARP IN LITHUANIA

A reservoir for live fish has been built on the Neman River downstream from hydroelectric power station feeding Kaunas, Lithuania. The reservoir is filled with warmer water from power station and does not freeze over in winter.

Carp Available Longer Period

Already, 40 metric tons of carp raised in local hatcheries have been placed into the 400-ton-capacity reservoir. Kaunas stores will be supplied with live carp through March. In the past, live carp was marketed only during a short period in autumn. ('Pravda', Dec. 16, 1970.)

ICELAND

1970 CATCH WAS SLIGHTLY ABOVE 1969

Iceland's 1970 fishery catch is estimated at 720,000 metric tons, compared to 689,400 in 1969. Herring continued poor: only 45,000 tons were landed. While this was a slight drop from 1969's 56,900 tons, it was only a fraction of the 461,500 tons caught in 1967.

The groundfish catch of 469,000 tons was up slightly from the 390,100 tons in 1969, but it was less than expected. Lobster, scallop, and shrimp catches reportedly rose.

Board Raises Prices

As 1971 began, the Iceland Fisheries Pricing Board raised the average landed price of fish by 25%--including 35% for haddock (in short supply) and 27% for cod. Retailers reacted with 15% increases.

Vessel owners and fishermen negotiated contracts for 1971 during the last days of 1970. By mid-January, unions had ratified most, but not all, agreements. Owners and officers still had not agreed. The officers went on strike as their vessels returned to port. (U.S. Embassy, Reykjavik, Jan. 13, 1971.)

DENMARK

REPORT ON GREENLAND'S COD FISHERIES

Greenland's 1970 catch of cod was about 17,000 metric tons (gutted weight), a 28% decline from 1969; and the latter was 44% below 1962 record. Poor catches may be expected for several years because there is no evidence of improvement in recruitment.

Most of the current fishery is based on the 1963-65 year-classes. The year-classes since then have been relatively small, so the cod stock is expected to be low until 1974. Hope lies with the 1965 year-class now entering the fishery.

Catch by All Nations

The cod catch by all nations fishing off West Greenland was 230,000 tons in 1969, the lowest since 1959. A decrease in effort since 1967 is one reason for the decline. Efforts were directed toward Labrador and the northeast Arctic, where conditions were somewhat more profitable.

In 1969 and 1970, an enormous ice field hampered fishing. Simultaneously, large amounts of cold polar water arrived. Temperatures at West Greenland fishing banks were unusually low.

Large Stern Trawlers Ordered

Most cod now are taken in inshore waters by small boats. Four large longliners fish on offshore banks, where foreign fleets have caught about 90% of annual total.

To remedy uncertainties of inshore fishing, and to ensure steadier fillet-plant operation, the Royal Greenland Trade Department (RGTD) contracted for large new stern trawlers. The first entered fishery in May 1969. Another, the 'Nuk', landed 1,618 metric tons of cod (gutted weight) during 1969, and about 2,700 tons in 1970.

Two larger stern-trawlers, nearing completion, will start fishing this summer. These vessels are 58 meters long, 11 meters wide, and have a hold capacity of about 550 cubic meters. The Nuk had only 280. They are equipped with double trawl rigs and reinforced hulls. The trawl winches will be located aft of bridge on boat deck. This is believed to be especially advantageous in waters heavy with drifting ice. Crew quarters include 24 one-man rooms.

Since the need was great to obtain offshore fishing capacity this year, a Norwegian trawler was chartered and it fished from Sukkertoppen.

The Danish Ministry for Greenland has contracted for two 700-gross-ton stern trawlers to be ready in 1972 and 1973. These will be 58.6 meters long and cost US$8.2 million each. In 1973, RGTD plans call for a 7-vessel trawler fleet.

U.S. Big Market

Sixty percent of catch now is used to produce frozen fillets and blocks. Practically the entire production is exported to the United States. (Reg. Fisheries Attaché, Copenhagen, Jan. 14.)

LATIN AMERICA

PERU

MINISTER OF FISHERIES REPORTS 1970 WAS GOOD YEAR

On the first anniversary of the Ministry of Fisheries, the Minister, General Javier Tantalean V., reported on the status of Peru's fishing industry.

Over 200 companies are fishing. These employ about 32,000 fishermen: 20,000 for anchoveta, 12,000 for other fishing.

As of Nov. 9, 1970, exports had generated $320 million of foreign exchange; the industry is paying $32 million in taxes to the government. Foreign-exchange earnings were about $100 million greater in 1970 than in 1969--and $50 million more than estimates for the sector contemplated in the National Plan for Economic Development. This paves way for improvements in industry efficiency and commercialization.

1970/71 Fish Catch

Regarding 1970/71 season catch, Tantalean said it would be reduced by about 500,000 metric tons on recommendations of Peruvian Marine Institute. Total fish catch permitted for 1970/71 season has been fixed at 10 million metric tons; catch was 10.6 million metric tons in period 1969/70. This measure had been adopted, he said, to assure normal growth and preservation of the species, and to assure jobs for fishermen and their families. The Minister regarded fish catch of nearly 4.5 million metric tons in second-half 1970 as "a very good semester."

Closed Season

The Minister stated that closed season for both fish and shrimp catch will be January and February of each year. It will be rigidly enforced.

His Ministry is thinking of planting trout and troutlike fish in lakes and rivers throughout Peru during 1971 to improve fish production for home consumption.

Fig. 1 - Peruvian "anchovetera" with hold and decks full of fish unloading at Chimbote.

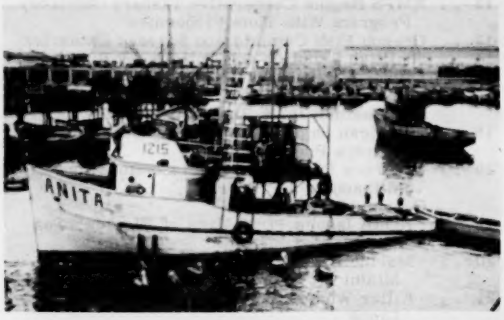


Fig. 2 - A typical small purse-seiner of the anchoveta fleet waiting to unload.

He believes the industry is in good shape. It is improving steadily as a foreign-exchange earner.

New Law Awaited

In an earlier statement, the Minister had said that the new Fisheries Law would be published "before the end of the present year" (1970). All attention is centered on whether the new law will contain provisions creating "fishing communities" similar to the "industrial communities" recently decreed for the industries. If it does, and the betting is that it will, the question is what such a determination will mean in terms of new investments and orderly growth for this important sector of Peru's economy. (U.S. Embassy, Lima, Dec. 24, 1970.)

INDEX

Page

UNITED STATES:

1 . . Supreme Court Upholds Army Engineers' Veto of Florida Dredge Plan
3 . . U.S. & USSR Sign Mid-Atlantic Fisheries Agreement
5 . . U.S. & USSR Sign 3 Agreements
8 . . Yellowtail Flounder in Serious Decline
8 . . New England Landings & Values Rose in 1970
9 . . Monitor Spawning Haddock
9 . . NMFS Studies Herring Off Maine
10 . . E. Coast Deep-Water Lobsters Transplanted in Pacific NW
10 . . Record Shrimp Catch Set on Pacific Coast in 1970
10 . . Commercial Fishing Course at Bellingham, Wash.
11 . . Study Effects of Starvation on Swimming of Young Jack Mackerel
11 . . Generations of Plankton Reared in Lab
11 . . 3,325 Whales Pass Yankee Point, Calif., in 67-Day Census
12 . . NMFS Begins Cooperative Fishery-Advisory Program With Tuna Fishermen
13 . . Oregon Fish Commission Surveys Estuaries
14 . . Shellfish Situation and Outlook, by Richard W. Surdi & Donald R. Whitaker
16 . . The Chesapeake Bay Rock Crab, by Dr. Paul A. Haefner Jr. & Roy T. Terretta
18 . . American Samoa Gets Fishery Statistical Analysis Project
19 . . Undersea Research Vessel Commissioned for Smithsonian

Oceanography:

20 . . NOAA Issues First Maps of Florida's Seaward Boundaries
20 . . Marine Science Center Is Dedicated in Miami
21 . . Killer Whales Seen Pursuing Steller Sea Lions
21 . . Decades-Old Ocean Data May Be A Clue to Today's Pollution

ARTICLES:

22 . . FPC: The NMFS Experiment & Demonstration Plant Process, by Robert C. Ernst Jr.
29 . . Current Skipjack Oceanography Cruises in Eastern Tropical Pacific Ocean, by F. Williams
39 . . Factors Affecting Exvessel Prices of Skipjack Tuna in Hawaii, by Yung C. Shang
42 . . A Buoyline Coiling Device, by Ian Ellis and Gary Loverich

Page

ARTICLES (Contd.):

46 . . Technical Note: Fish Proteins As Binders in Processed Fishery Products, by R. J. Learson, B. L. Tinker, and L. J. Ronsivalli
51 . . Glucose Oxidase Reduces Oxidation in Frozen Shrimp, by Carolyn Kelley

INTERNATIONAL:

53 . . World Fish Meal Production Rises

Asia:

Japan:

54 . . Japanese Are Pessimistic About 1971 Fishery Exports
55 . . Fishery Budget Is Raised for Fiscal Year 1971
55 . . Saury Prices Rise As Landings Fall
55 . . Squid Fishing Off U.S. East Coast Improves
56 . . Report on Shrimp Industry Trends
56 . . Imports of Frozen Shrimp from Africa Are Increasing
57 . . Hiroshima Oyster Growers Worry About S. Korean Imports
57 . . Nichiro Is Purse Seining Off West Africa
57 . . Record Mothership-Type Bottomfish Catch in Bering Sea in 1970
58 . . Tokai University Cultures Tuna Species and Dolphin
58 . . Underwater Habitat Nears Completion
59 . . Phases out Fishing in New Zealand Waters
59 . . Large Purse Seiner Launched

Taiwan:

60 . . 1970 Fish Production Increased 9.3% Over 1969, by T. P. Chen
60 . . Plans to Build Tuna Longliners

Europe:

USSR:

61 . . Buys Fish-meal Plants from Denmark
61 . . 'Frost-Proof' Reservoirs for Live Carp in Lithuania

Iceland:

61 . . 1970 Catch Was Slightly Above 1969

Denmark:

62 . . Report on Greenland's Cod Fisheries

Latin America:

Peru:

63 . . Minister of Fisheries Reports 1970 Was Good Year
64 . . INDEX

☆U. S. GOVERNMENT PRINTING OFFICE : 1971 435-340/8

BACK COVER: A Korean woman in fish market at Inchon with string of squid. (FAO photo)